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No.5 July 85p



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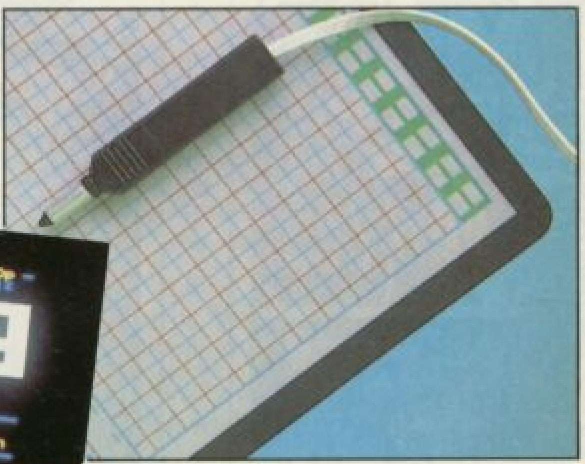
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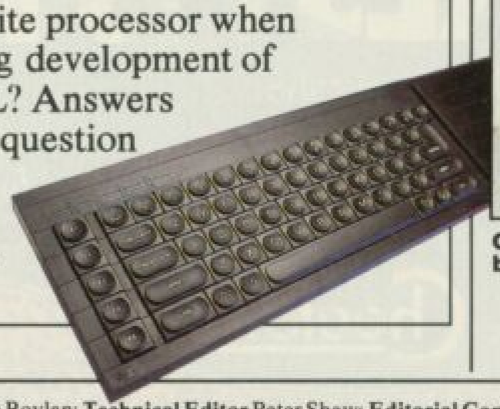
INSIDE YS

FEATURES



ON THE BENCH



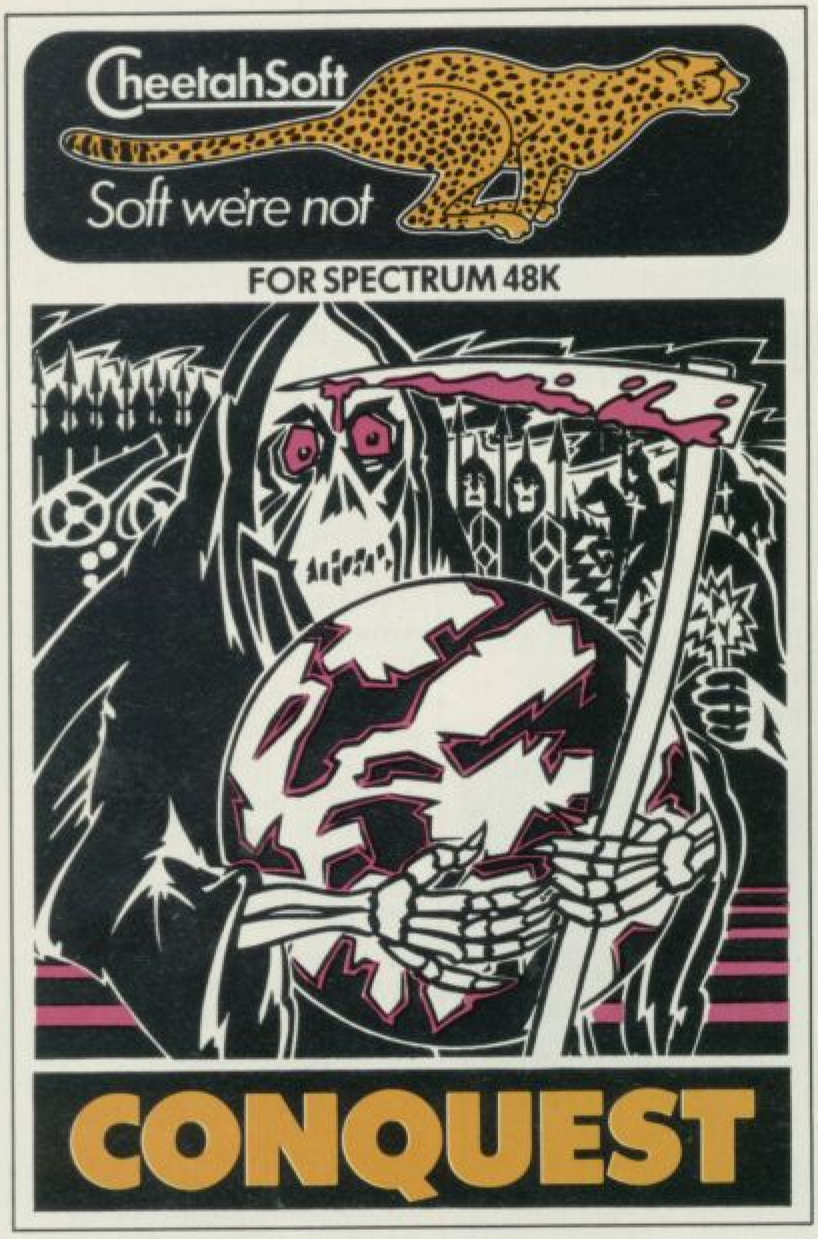


REGULARS



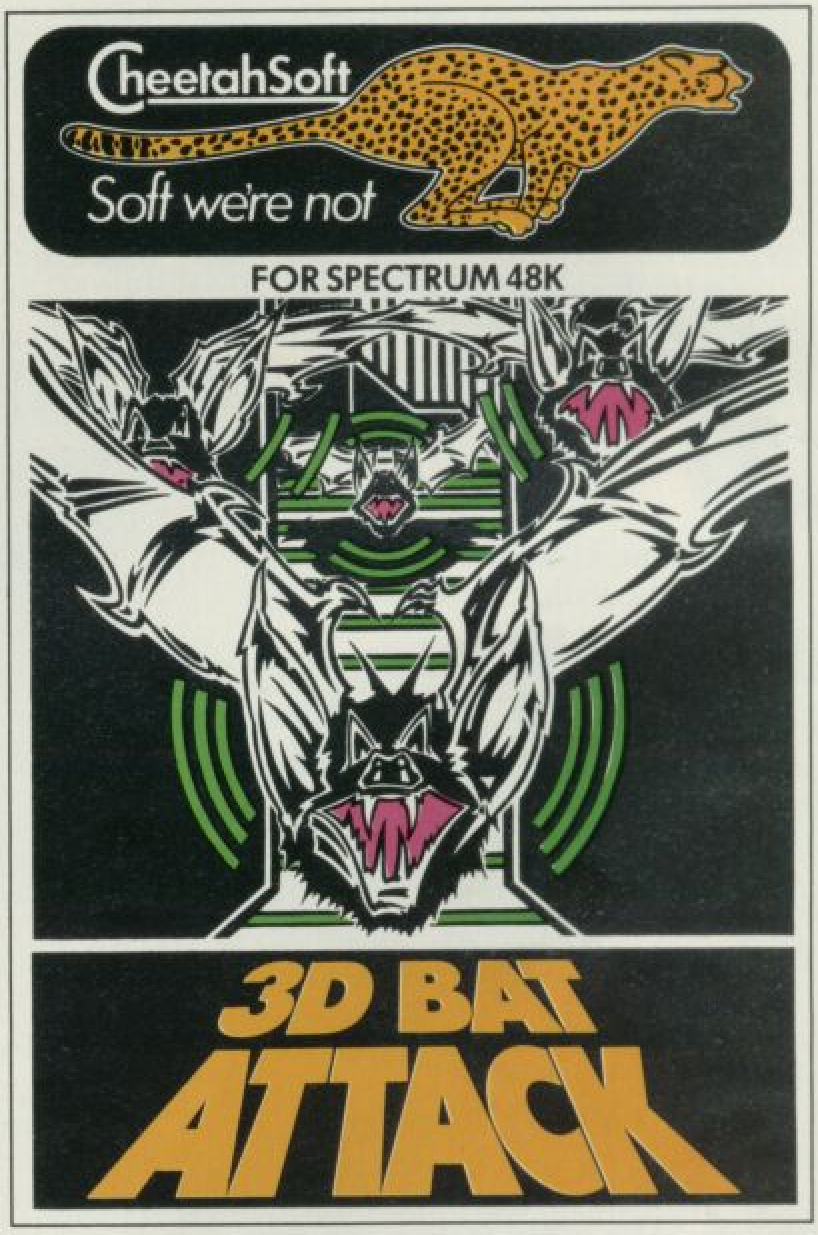
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3D BAT ATTACK An all action, 3 dimensional maze game where you gather up blocks of gold, at the same time pitting your wits against vicious vampire bats whose only purpose in life is to locate, hunt and kill you.

4 levels of skill. At each level the game gets faster and more complicated, and the vampires more dangerous.



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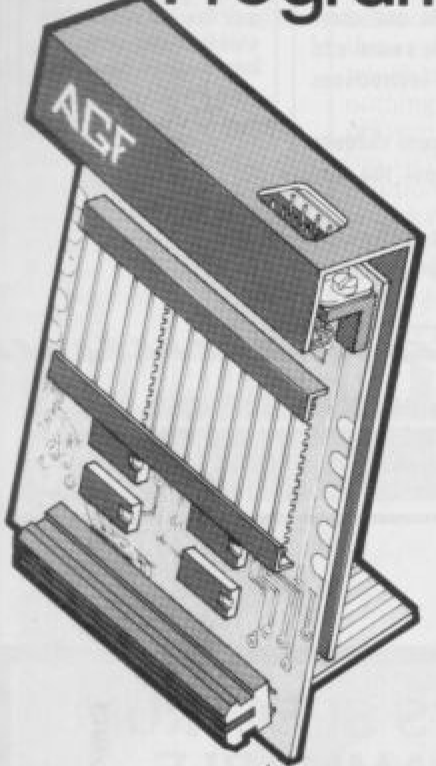
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JOYSTICKS
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INTERFACES

Programmable Interface



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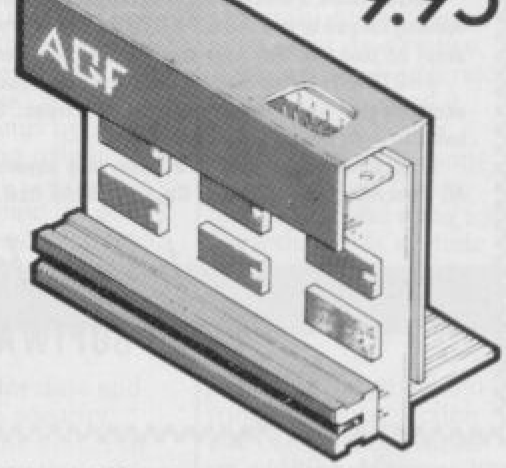
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for 48K ZX Spectrum

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Y.S.

FRONTLINES

CHEER UP HARD COPY

Cheltenham-based Euroelectronics has produced a piece of software for Spectrum owners called *Copy Four*, that will allow users of the company's ZX LPRINT Centronics and RS232 interfaces to reproduce four colour printing on the MCP 40 and Tandy CGP 115 printers.

There are two versions available, for £5.50 each. The first is in machine code for the issue 3 model, while for owners of earlier models or other manufacturer's interfaces the other version is written in Basic.

Phone 'em on 0242 582009.

LICENCE TO QUELL

There's still some confusion surrounding the anti-copying system developed by Jim Lamont, of JCL Data — that's the one that was banned by the Ministry of Defence when a patent was first applied for, because it might have proved to be a risk to British security.

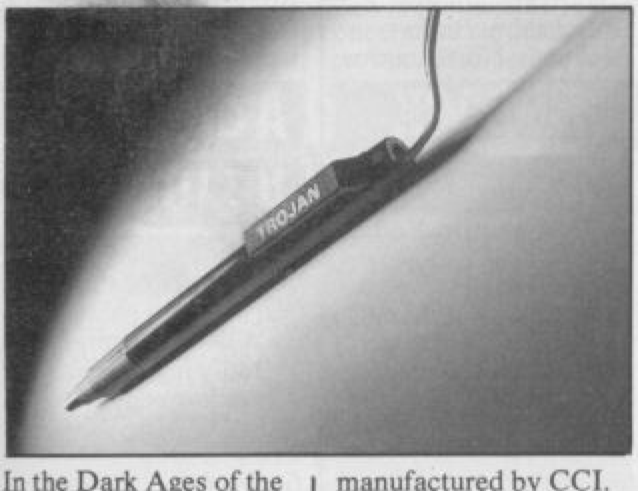
The commonly held belief is that the new (post MoD) system is only now being produced because no patent has been applied for — which means that nothing can be done to prevent its use. This is the view held by GOSH (Guild Of Software Houses) member, Rod Cousins, who is firmly in favour of anything that will prevent piracy.

However, Jim Lamont explains, "The current system, for which I have applied and been granted a patent, is based on one of my very early ideas". And while it's apparently not disimilar to the one banned by the MoD, it's only about 95 per cent efficient, whereas the other was virtually, if not totally, 'crackproof'. All of which seems to suggest the MoD thinks national security could be at risk if private companies or individuals had the capability to store information that was beyond the reach of government security organisations. Perhaps Orwell's *1984* is really with us after all.

Mr Lamont went on to explain that JCL Data will be offering a complete service to interested companies, by supplying them with the 'basics' of the system he *is* allowed to sell — for which they will pay a fee, and from which they will be able to produce their own, customised devices. He says, "Once this has been done, companies must return two copies of each system to us, by post. One will be retained, unopened, to prove on which date it had been implemented, and the other sent to the Trading Standards office. After this, anyone caught trying to break the 'code' (so to speak) will be taken to court by JCL for breaking patent regulations." Any action would be paid for out of the previously collected licence fees. So far, JCL's device has attracted favourable attention not only from GOSH, but also the Trading Standards Office, the Consumer Protection Bureau and the Fraud Squad.

The software industry is already showing interest in the device, in particular some tape duplicating companies. BB Magnetics, for example, has already applied for, and been granted, a licence. And A&F Software is currently customising the system for its own use. A&F's Mike Fitzgerald says, "We've tried it, and are quite happy. Anything that prevents or discourages piracy must be a good thing for the industry as a whole."

THE WRITING ON THE SCREEN



In the Dark Ages of the Spectrum, the only light pen to be had was a nearly useless converted biro from a company that now concentrates on its software.

However, two new light pens have arrived on the scene — one from Trojan and the other is manufactured by CCI. Both are custom-made light pens, and both are supplied with user-friendly software.

The Trojan Pen costs £19.95 and is available from PSL Marketing on 0582 591493. The CCI costs £15 — details on 0799 25014.

I WANT MONEY. . .

Those with more money than they know what to do with — or no money (which is just as difficult to organise) — may appreciate a couple of new programs designed to help them sort themselves out.

The first is *Home Budget*, a package that sets out to enable people to keep track of finances and build up a file of incomes and expenditures. These can be used in 'what if' calculations, and income and expenditure can be produced in clear tabulated form or as a bar chart. All data can be logged for date and time and is security coded by the user. For more information, chase up Kuma Computers Ltd on 07357 4335.

The second program, from Sinclair Research, is called *Which? Tax Calculator*. It's a personal tax program that will reckon accurately the true amount of tax owed for the 1983-1984 year. It's been written to include all relevant basic UK tax rates and allowances and is divided into three sections: the first defines personal circumstances and job earnings, including overtime and fringe benefits; section two contains questions on additional income like pensions, social security benefits and investment income; and the third covers personal allowances and outgoings.

The package is priced at £12.95 and comes on cassette with a 59-page reference manual. It's available mail order from Sinclair Research Ltd (phone 0276 685311) and through selected retail outlets. You never know —the cassettes might end up tax-deductible!

PAPERING OVER THE CRACKS

Sometimes it's a pain to have to order your computer stationery well in advance of running out, so Moore Paragon has launched a range of continuous stationery called *Blue Chip* which will be available soon through high street stationers and computer dealers. The first two products will appear as easy-to-carry boxes of 500 forms — green music-ruled for data listing, and plain Kleen Edge for letters and graphics.

MARVELLOUS NEWS

All fans of Marvel comics, capes at the ready, 'cos it's Superhero time! Adventure International (UK) Ltd is launching the first graphic adventure computer game featuring the Incredible Hulk. Adventure International in America has signed a licensing deal with the Marvel Entertainment Group to produce a series of software adventure games featuring such Marvel superfolk as Spiderman, Captain America and, of course, the Hulk.

Mike Woodroffe in the UK office explains that "Marvel will produce a comic to go with each game. The storyline is left at a certain point and you have to go to the tape to continue the adventure." At last we'll have the chance to actually take part in the adventures, and as Mike Woodroffe points out "the potential is tremendous". This could really be something to look forward to. . .



ANT-ICIPATION OVER

For all of you out there who've been waiting with breathless anticipation for the results of our Ant Attack Competition from issue 2, here they are at last. Our first-prize winner was Michael Kipling from London and he was invited up to Prism's luxurious offices to collect his prizes. Needless to say he wasn't expected to cart the whole lot home on the tube, but he did just about manage to take the hardware with him.

We thought we'd better question him on how he managed what we considered to be a pretty awkward game and his reply was: "Well it took me about a week to get through all the levels, and then on the phone-in day it took four hours to find the box marked AMMO". That's pretty fast; if he keeps that up he'll probably be through the software prizes in a couple of months!

Pictured here are (from left to right) Bruce Sawford, our Managing Editor, Roger Munford, our manic Editor, Michael himself and, finally, Bob Denton, Managing Director of Prism.

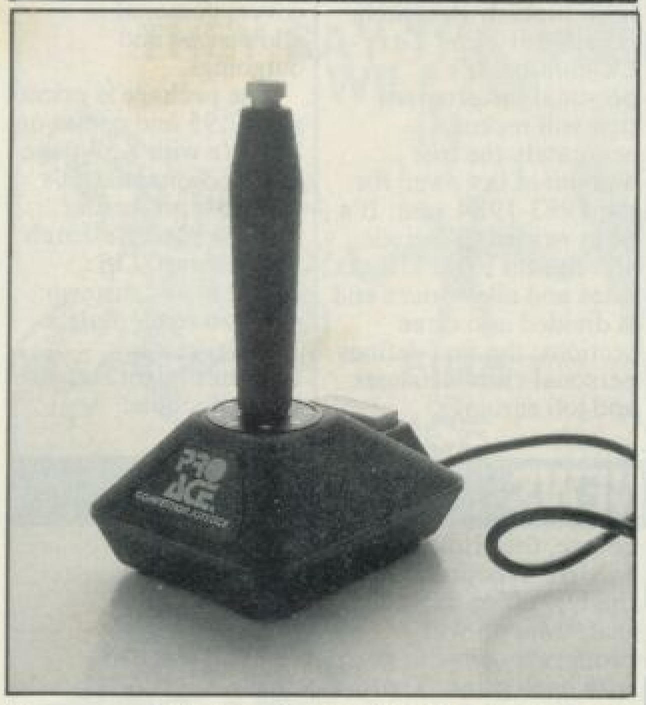
Three other people win prizes of £100 worth of software and they are: J Cattey of East Colchester, Essex, Matthew Spasioni of Leicester and Richard Ovis from St. Albans. Could these three write to us confirming their addresses. The following 25 winners each receive a year's subscription to this wonderful magazine and we'd like them to write into us with their exact addresses and information on when they'd like their subscriptions to start.

Here goes. . . David Green, Sheffield; Christopher Hall, Belfast; Mark Suman (unintelligible address); Ian Kerns, Hayes, Middlesex; David



Thompson, Nazeing, Essex; David Saunders, Nottingham; Mike Often, Framlingham, Suffolk; Nicky Rutter, Whitley Bay; Philip Daniels, Shanklin, IOW; Paul Mark, Hull; N Emery, Leeds; Mr Lamb, Aylesbury; Mark Little, Belfast; Michael Wiecko, Wrexham, Clwyd; Vincent Kelly, Northwood Hill; Chris Desilva, Bedford; Colin Konpyrka, Maidstone; Alan Brigman, Bristol; S Hart, Goldthorpe, S Yorkshire; Robert Beckwith, Northampton; Michael Church, Camden Town, London; Andrew Watt, Solihull; David Salem, Liverpool; and could Daniel (Something or another) from Leatherhead and Brian (Whatshisname) from Orpington contact us as soon as possible.

IT'S ACE!



Hey . . . wow! The Pro Ace joystick is priced at £12.95 and (it says here) is robustly constructed with particular emphasis on its ease of use. There's a centre Fire button plus a dual action Fire button on the front of the base for left- and right-hand playing (just call me Andy Dextrous). The switches on the Pro Ace have been destruction tested to over a million simulated operations (and 38 worn-out fingers?!?) and this allows Sumlock Microware the confidence to dish out a two year replacement warranty on the 'stick. The Pro Ace can be used with any 'standard' Spectrum joystick interface; word has it there'll soon be one coming along from SM themselves. You'll get a Pro Ace either through mail order direct from the company or from selected retail outlets. Ring Sumlock on 061-834 4233.

VEGETABLES FIGHT BACK

With everybody fed up to the back molars with invading aliens, it's now the turn of marauding vegetables. Difficult as it may be to believe, after *Revenge of the Killer Tomatoes*, comes *Vegetable Crash* from Kuma.

It's a machine code program that runs on the 48K Spectrum and the scenario goes like this: you are being attacked by battling vegetables and under fire from exploding seeds. You have three lives and there's nowhere to hide — so watch out that those crazy carrots don't break ranks and try to crash into you.

At £6.95 this may sound a bit 'weedy' (*yuch! Ed.*), but anyway, it should be available from all well-fertilised micro stores.

FLOODS OR FAIR WEATHER

The Essex Exhibition Centre is planning to hold a home computer fair at the Old St John School, Chelmsford, in the next couple of months. Says organiser Lance Feller, "Exhibitors won't have to pay to attend, but visitors will probably be charged £1 per head".

Mr Feller was also responsible for Chelmsford's first business computer fair back in April, when approximately 300 visitors attended. He says, "This show wasn't quite as successful as we'd hoped, because we had one problem after another. On the previous night a burst pipe caused a major flood, and I was working until four in the morning mopping up the mess."

If you fancy a day at the fair, you can catch Lance on 0245 252900. But don't forget your Wellington boots!

A SERIOUS VISION

Visions, of London W6, has recently launched its first business package for the 48K Spectrum.

Oddly named *Sci File*, the package consists of a *Program Generator* and a *Report Program Generator*. The former allows you, without any knowledge of Basic, to create a database of a structure and design that you can tailor to personal requirements. The second program in the package, the *Report Program Generator*, allows you to access your database and display it in various formats.

There's two ways we can look at this: either games software houses should stick to games software, or Visions was offered something so good, the company couldn't refuse it. Whichever, Visions (Software Factory) is selling *Sci File* at £19.95; the company's phone number is 01-748 7478.

THOSE WISE VIRGINS

Regular visitors to the West End of London will probably remember the famous 'green' Games Centre shops. These stores sold all manner of toys and games, from *D&D* to Dominoes and Computer Battleships to *Rubic's Cube* — until one day, an acute cashflow problem caused the closure of all branches.

But here's the good news, for store *numero uno* in Oxford Street has recently been taken over by the Virgin Empire. Yes, in the turbulent wake of the Virgin 'cross-the-Atlantic-for-under-a-ton' scheme, multi-millionaire tycoon Richard Branson has decided to launch his own Virgin Games Centre.

The store looks surprisingly similar to the way it did before. The bottom, or ground, floor is stacked with the usual toys and games, but the top has been taken over by the home computer department — obviously because Virgin already has interests in that direction.

Checking out the shelves of the upstairs dept, one can't help noticing an obvious lack of plugging for Virgin's own-brand software. Apart from a few copies scattered amongst the racks full of rival product, the only push for Virgin Games is a small poster pinned to a pillar. The computer department's Les Baker said this was because, "we're going for new releases rather than just our own games" — a refreshing lack of bias indeed, and probably good commercial sense to boot.

Once the centre has become more established, the plan is to move away from the VCS-type machines and concentrate on the home market. Wise people. There are also going to be special offers where you get 'nine for the price of five', or whatever. If this pilot store is a success, then Virgin hopes to open similar centres in other areas of the country.

The Virgin Games Centre is only a couple of doors away from the Virgin Megastore at the Tottenham Court Road end of Oxford Street. Find out more by going there —or 'phoning 01-637 7911.

Still on Virgin ground, the games company has recently been expanding its operations. In a major change of strategy, Virgin has decided to become more than a mere publishing house. "We have decided to create a small team of in-house programming talent to develop unique creative software," said a spokesman. If you think you've got it — and Virgin want it — pop round to 61/63 Portobello Road, London W11 and check it out.

PEEK WHEN YOUR SPOKEN TO



Micro Command is a new speech recognition system that can be used initially with games, but after a bit of practice you can use the routines provided for systems of your own design. Included in the package is an interface, a microphone and a cassette containing various programs ranging from an introduction to speech recognition through to a game called Sheeptalk which has you rounding up sheep by giving verbal commands to a sheepdog! Micro Command has a recommended retail price of £49.95 and is available from high street shops. In case of difficulty call Orion Data Ltd on 0273 672994.

YOU DIRTY RAT



Now get dis. Da latest game from da Melbourne House mob is called *Mugsy* and it's da first gangster game wid comic-strip speech in da language of da great days of Chicago in da 1920s. Just ta give us bored ol' journalists a bit uva surprise like, Melbourne House sent da boys around wid da review copies. Jeez' when da two lads wid da violin cases walked in, our receptionist just hit da ground. Ah mean, dese tings just don' happen in Rathbone Place.

Da game has bin designed using da *Melbourne Draw* utility program and de aim is ta be da toughest an' most powerful mobster in town. Ya buy da mob's artillery and ammo, bribe da cops, organise da protection rackets and most important, makka lotta dough. *Mugsy* costs £6.95 and works on da 48K Spectrum. Don' a miss da review soon inna da mag — or dere'll be trouble! OK!!

EXPANDING BOUNDARIES

WH Smith is planning to extend its range of Computer Shops by the beginning of September this year. The company describes these shops-within-shops as having a 'relaxed' atmosphere where you can sit in comfort at console units and use complete systems — as well as being able to make full use of the computer staff's expertise. John Rowland, the Merchandise Controller for Smiths, says "We want people to be able to try out the hardware for themselves and have the opportunity to discuss and compare the various computer specifications and software packages with our specially trained staff." Another idea is computer exhibition evenings to demonstrate the specific use of computers and peripherals.

Of the company's 355 retail shops, 50 will contain Computer Shops and 220 will have 'know-how' departments by September this year. New Computer Shops are being opened at Bolton, Chester, Coventry, Derby, Lewisham, Oxford, Preston, Southend, Sunderland, Watford and York; and 'know-how' departments will appear at (take a deep breath) Basildon, Bedford, Blackpool, Bournemouth, Bradford, Chelmsford, Cheltenham, Colchester, Crawley, Guildford, Hanley, Harlow, High Wycombe, Ilford, Luton, Peterborough, Putney, Nottingham, Richmond, Slough, Solihull, Stockport, Sutton, Swindon, Woolwich and Worthing. Computer evenings are planned for Birmingham, Cardiff, Glasgow, Kingston, Leeds, Leicester, Liverpool, London (Holborn Circus and Brent Cross), Nottingham, Reading, Southampton and Swansea. (Whew!)

TO HELL WITH SOFTWARE

Richard Shepherd Software, revealed recently in *YS* as the recipient of one of our coveted Strangled Turkey awards has launched another game in its 'Adventures Into Imagination' series. The offering, entitled *The Inferno* is based around Dante's concept of Hell —as laid out in his book, *Inferno*.

Hobbit fans will probably feel at home with the interactive characters. Here, however, the idea is taken one step further in that any character may befriend you, or become your enemy.

The Inferno was released on June 1st, and retails at £6.50 for the 48K Speccy. More details from Richard Shepherd Software, 23-25 Elmshott Lane, Cippenham, Berks.

among the users of BRITISH MICRO GRAFPAD are...

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- The Finance & Estates Officer, University College of Swansea
- University of East Anglia, School of Biological Science
- Westfield College, University of London
- Westfield College, Department of Zoology, University of London
- School of Physics, University of Newcastle upon Tyne
- Oxford University Computing Service
- The University of Warwick
- University of Aberdeen, Department of Geography
- The University of Sussex
- University of Bristol
- Heriot-Watt University Dept. of Civil Engineering
- The New University of Ulster
- The University of Strathclyde
- The University of Southampton
- University of Liverpool
- The University of Aston in Birmingham
- University of Keele
- University of Surrey
- University College of London
- The University of Dundee, Microcomputer Centre

POLYTECHNICS

- Thames Polytechnic
- Polytechnic of the South Bank
- Coventry (Lanchester) Poly
- Dept. of Applied Chemistry Coventry (Lanchester) Poly
- Newcastle upon Tyne Poly
- Manchester Polytechnic
- Hatfield Polytechnic Dept. of Psychology
- The Polytechnic
- Leeds Polytechnic
- Kingston Polytechnic
- City of Birmingham Polytechnic
- Middlesex Polytechnic
- Plymouth Polytechnic
- Portsmouth Polytechnic
- Ulster Polytechnic
- Liverpool Polytechnic

COLLEGES

- Chelsea College, University of London
- Guildford C.C. of Technology
- Kings College, London
- University College of Swansea
- Statistics Department, Computer Centre Building, University College of Swansea
- Nene College, Computer Services
- Cambridgeshire College of Arts and Technology
- London Borough of Havering, The Principal Havering Technical College
- Blackpool and Fylde College
- Jordanhill College of Education
- Bromley College of Technology
- Guildford County College of Technology
- Kilmarnock College
- Wearside College of F. Education
- Wearside College of F. Education, Dept. of Electrical & Mining
- Newark TC School/College
- National College of Agricultural Engineering
- Bradford & Ilkley Community College
- Goldsmiths College
- College of Arts & Technology
- Head Craft, Design & Tech.
- South London College
- St. Columbus College
- Robert Gordon's Institute of Technology
- Chelmer Institute of Higher Education
- Southwark College, Maths/Physics Department
- Newark Technical College
- Matlock College of Higher Education
- Wakefield District College
- Barnsley College of Technology
- The College of St. Paul & St. Mary
- Thanet Technical College
- Ballymena Technical College
- Cannock Chase Technical College
- Lancaster & Morecambe College of Further Education
- Uxbridge Technical College
- New College Durham
- Bath College of Higher Education
- North Trafford College
- Dept. of Educational Resources
- Southampton College of Higher Education
- Bournemouth and Poole College of Further Education
- Harrow College of Higher Education
- Southall College of Technology
- Shirecliffe College
- Southwark College
- Dewsbury & Batley Technical & Art College
- Tresham College
- Ware College
- Thurrock Technical College
- Chicklade College, Dept. Science & Technology
- Redbridge Technical College
- South Thames College
- York College of Arts & Tech.
- Somerset College of Arts & Technology
- Borough of Trafford, North Trafford College
- North Trafford College
- Thurrock Technical College
- Thurrock Technical College, Computer Department
- Fairham Community College
- Mid College of Higher & Further Education
- East Ham College of Technology
- Seale-Hayne College
- Homerton College
- Uxbridge Technical College
- North Oxfordshire Technical College & School of Art
- Ealing College of Higher Education
- Welsh National School of Medicine
- Lord Mayor Treloar College
- South East London College
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- Strode's College
- Dundee College of Education
- Isle of Wight College of Arts and Technology
- Kendal College of Further Education
- Wigan College of Technology
- Chippenham Technical College
- South Devon College of Arts & Technology
- South Shields Marine & Technical College

SCHOOLS

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- Longton High School
- Berry Hill High School
- Camborne School of Mines Management Department
- School of Physics
- Queen Philippa's School
- Carter Lodge School
- Ashfield School
- All Hallows School
- Mead Vale Primary School
- Vincent Thompson High School
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- Imberhorne School
- Newham School for the Deaf
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- Beaumont School
- Billericay School
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- Clarendon School
- The Lavinia Norfolk Unit
- St. John's C of E Primary School
- St. Peter's High School
- Rock Ferry High School
- Stoke on Trent Language Centre
- Connah's Quay High School
- Buckhurst Hill County High School
- Harlington Upper School
- Heath Comprehensive School
- The High School Ballynahinch
- Bishop Hedley High School
- Clwyd Lea School
- Monks Dyke High School
- King Edward's School, Bath
- The Godolphin & Latymer School
- Frances Bardsley School
- Shaw House Comprehensive
- New Parks School
- St. Paul's Way School
- Larkman Middle School
- Rushcroft High School
- Training and Educ. Management
- High Green School
- Ogmore Comprehensive School
- Brakenhale School
- Oxford International Business School
- Hampstead School

GOVERNMENT DEPARTMENTS

- Hertfordshire County Council Advisory Unit for Computers
- Leicestershire County Council
- The Director of Finance & Administration, Cambridgeshire County Council
- The National Institute for Medical Research
- Department of the Environment Building Research Establishment
- Kent County Council Education Department
- Ministry of Defence
- Basildon Council Accounts Department
- Department of Trade
- Devon County Council Committee, Department of Electrical Eng. College of Further Education
- Strathclyde Regional Council,
- County Borough of Sunderland
- Kent County Council
- Nottinghamshire County Council
- Basildon District Council
- City of Newcastle upon Tyne Education Committee
- Hampshire County Council
- Buckinghamshire County Council, Education Services
- Cambridgeshire Education Committee
- Metropolitan Borough of Gateshead
- Cleveland Education Committee, Guisborough Teachers Centre
- Metropolitan Borough of Rochdale, Education and Training Centre
- Leicestershire Education Committee
- Department of Industry & Trade
- Leicester Info. Tech. Centre
- Solihull Education Department
- Manpower Services Commission, Training Services Division
- Skill Centre Training Agency
- Powys County Council
- Information Technology Centre
- East Berkshire Health Authority
- Devon County Council Ed. Comm.
- Mid Surrey Health Authority
- Epsom District Hospital
- Scottish Council for Educational Technology
- Clwyd County Council
- Norfolk Education Committee
- Agricultural & Food Research Council
- Mid Glamorgan County Council Education Department
- Kent County Supplies Centre
- London Borough of Barnet
- West Midlands Regional Health Authority
- Scottish Community Education Council
- The Scottish Adult Basic Education Unit
- Birmingham Social Services
- Microelectronics Education Programs
- Greater London Council
- Doncaster Metropolitan Borough Council
- United Kingdom Atomic Energy Authority

COMPANIES

- Cambridge Applied Micros
- Sirton Computer Systems
- Assurance Sun Life Court
- Radala & Associates
- Computer Services
- Laser Systems Ltd
- National Physical Laboratory
- Central Trade Exchange Ltd
- Software Invasion
- Argonaut Systems
- Integrex Ltd
- British Telecommunications
- B.T. Research Labs Accounts
- Windsor Wine Supplies
- Jannerlow Ltd
- Ibbotsons Design Software
- H.C.C.S. Association Ltd
- Molspin Ltd
- Fisons Pharmaceuticals, Pharmaceutical Division
- Information Technology Marketing
- Steele Microsystems Ltd
- The Television Centre
- Education & Microtech Unit
- British Telecom Enterprises
- Display Distribution Ltd
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- Walter Computer Systems
- Standard Telecommunications Laboratories Ltd
- Granada Computer Services Ltd
- Applied Systems Knowledge Ltd
- Cipher Systems and Communications Ltd
- Cogwell, Cornick Associates
- Ashfield Project Centre
- Andrew Shyte & Son Ltd
- Acornsoft
- Robot Technology Ltd
- British Shipbuilders (Training, Ed. & Safety) Ltd
- Boston Computers Handelsges
- Fisher Controls Ltd
- Timex Corporation
- Robot Technology Ltd
- United Kingdom Atomic Energy Authority
- British Aerospace Public Ltd
- Salam Group Ltd
- Plessey Avionics & Comm.
- Elite Software Co. Ltd
- Computer Advisory Unit, Chelmer-Institute
- Intec (Inverclyde) Ltd
- Universal Sonar Ltd
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- Edward Davies Chemical Labs.
- Pyramid Services Ltd
- Philips Research Laboratories
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- Microtronix S.A.R.L.
- Thomas Law Associates
- Transvideo Productions Ltd
- Dash Electrical & Electronic Services
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THE GRAFPAD comes complete with Cassette Programme, Special Keyboard, Overlay, Plug, Light Pen and, of course, a comprehensive manual full of tips and instructions . . . all at the usual high quality expected from **BRITISH MICRO!**





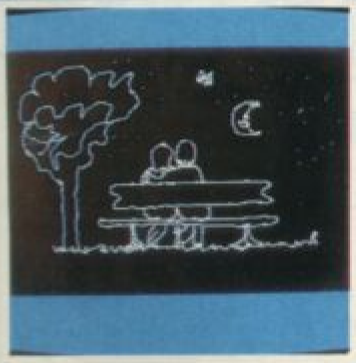


STARTING UP is simple. Connect the Grafpad, switch on your Spectrum and connect the cassette player, type "LOAD" and press ENTER, then start the cassette player, place the keyboard overlay, and by the time you are ready, the "MENU" will flash on to your screen! Usage? Well there is . . .

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	Postage, Packing & Insurance			£5.00
	TOTAL			£

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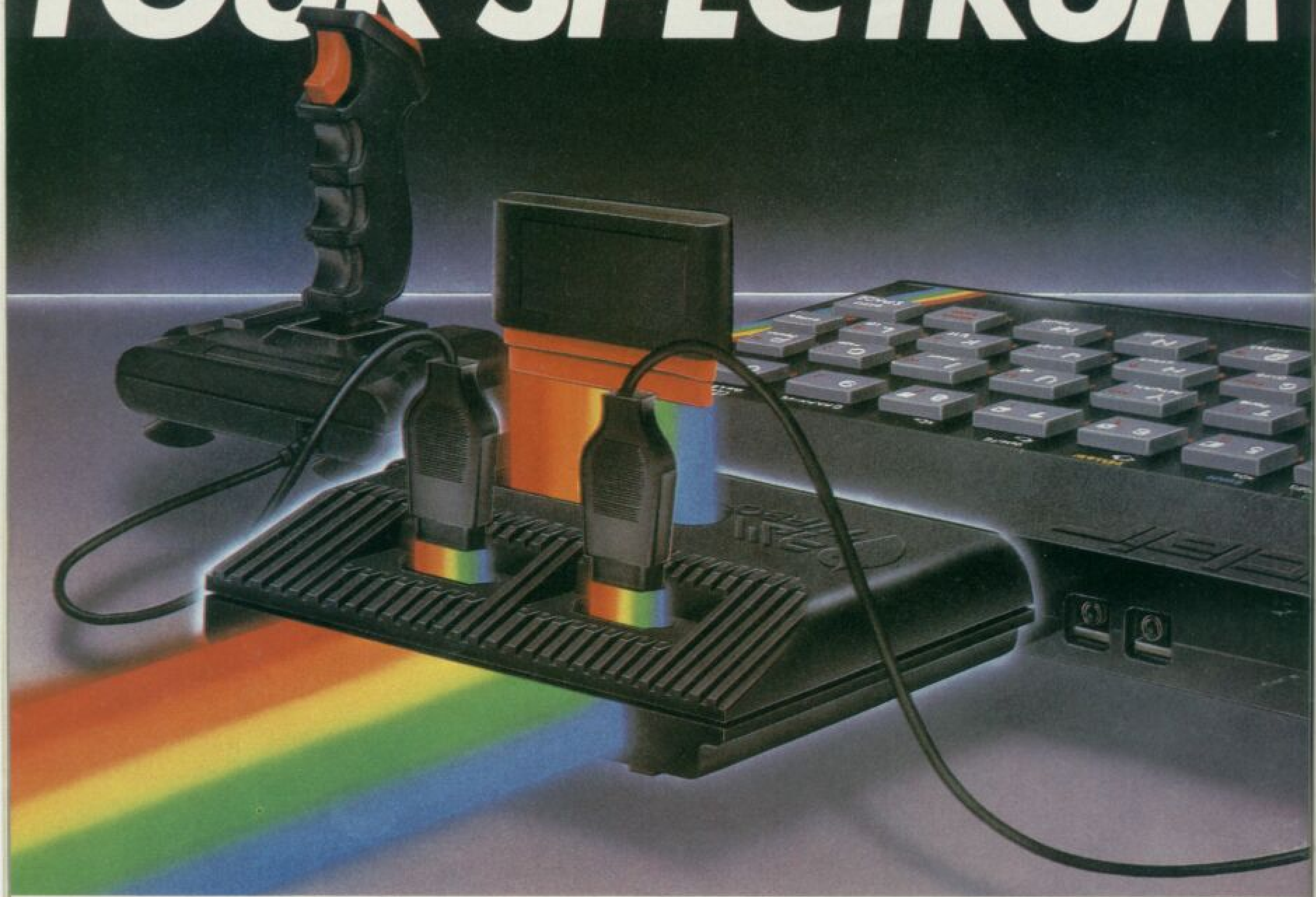
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RAM TURBO

Trade and export enquiries welcome.

POPPING THE QUESTION

So you think you know a lot about pop music — huh? Well, here's a package from Bellflower Software that could stretch the cells just a little. It's called *Stuart Henry's Pop Quiz* and is available for the 48K Spectrum.



Radio Luxembourg disc jockey Stuart Henry has sifted through more than 750 questions on pop music —from the Beatles through to Boy George —and the game can be played by either one or two players, with questions selected at random over each of six rounds.

But this isn't just a straightforward check on your knowledge of the music scene. At the start of each round the computer plays a short tune, then prints a blank musical stave on the scoreboard with a space for every note of the tune. When you've correctly answered a question, you get the chance to guess one of the notes in that tune; a correct answer will gain some extra points, but guess it wrong and ten points are knocked off your bonus score.

With a new mystery tune at the start of every round of every game and questions selected at random, *Pop Quiz* can be played over and over again. The game costs £5.75 and a donation is being made to the Multiple Sclerosis Society for every copy sold. The game is available from WH Smith.

LEVELLING UP

It's an irritating fact of adventures that you often encounter a puzzle that you just can't solve. Level 9 adventures have always included forms that can be returned for help when players get stuck and now L9 may indeed be the first UK firm to start an adventure help service.

Originally every enquiry needed a separate written reply and so last year the company decided to experiment by producing a comprehensive clue sheet for *Collosal Adventure*. The sheet was sent out in reply to all enquiries about the game. So successful was it that many people wrote requesting similar help for other games.

So now comprehensive clue sheets are available for all the L9 adventure products and they're free to anyone who sends the company an SAE. The sheets provide alphabetical lists of the objects, creatures and trickiest locations in each of the adventures. Some of the sheets have up to 580 entries in close-typed print but it's still relatively easy to look up where something is hidden or to discover how to solve some puzzle concerning it. Certainly it's a much clearer system than the straightforward question and answer approach.

Send your SAEs to Level 9 Computing, 229 Hughenden Road, High Wycombe, Bucks HP13 5PG.

THE DAY ZIP GOT ZAPPED!!

Last month's *Zip* article died the death of a thousand cuts when some demon scapel weilder decided to chop it up and stick the bits down in the wrong order.

If you find the article more confusing than usual, the following program (don't RUN it . . . just read it!) will shuffle the bits into the order I intended.

Alternatively, ace editor DOGER RUNFORM will spend his weekend making amends by slaving over a hot photocopier. Write in with stamped addressed envelope, if you'd like a free photocopy of the article, in the correct order.

This month's article has been split into two sections, so tht the last part of the series will appear next month. That is, unless Doger loses it!

Simon (fingers crossed) Goodwin

```
 100 IF page=47 AND column=3 AND paragraph=2 AND last line=errors may be detected  Once again the THEN  LET next line=line number and a full error message: GO TO page 48 column 2 paragraph 4
 110 LET page=48: LET column=1: LET paragraph=3: LET last line=generating instructions to put each next line is number or variable value ON A Stack: GO TO page 49 column 1 Paragraph 2
 120 IF page=48 AND column=2 AND paragraph=4 AND last line=Because the steps involved are not neces- Next line=sarily performed in the order they are THEN  GO TO page 47 column 3 paragraph 2
 130 LET page=49: LET column=1: LET paragraph=2: LET last line=through a table of lines  This means you: LET next line=can not say GO TO variable in a com: GO TO page 48 column 1 paragraph 3
 140 IF page=50 AND program line=5805 THEN  LET the smudged bit=26*8
 150 IF page=50 AND program line=6570 THEN  LET the end of the line=TO 6590: LET the program be rearranged to fit the gap and move the block=from 6560 to 6570 move down 4 lines
 160 REM If you misprint this I'll never forgive you.
```

Before you start typing, this program won't RUN — just read it through with issue 4's 'Adding Zip' article and all will be revealed.

PHONE FOR PETE

Ever since we announced the start of the *YS Helpline* for stranded readers, *Trouble-shooting Pete* has been deluged with phone-in problems. We asked him to report on some of the more interesting ones.

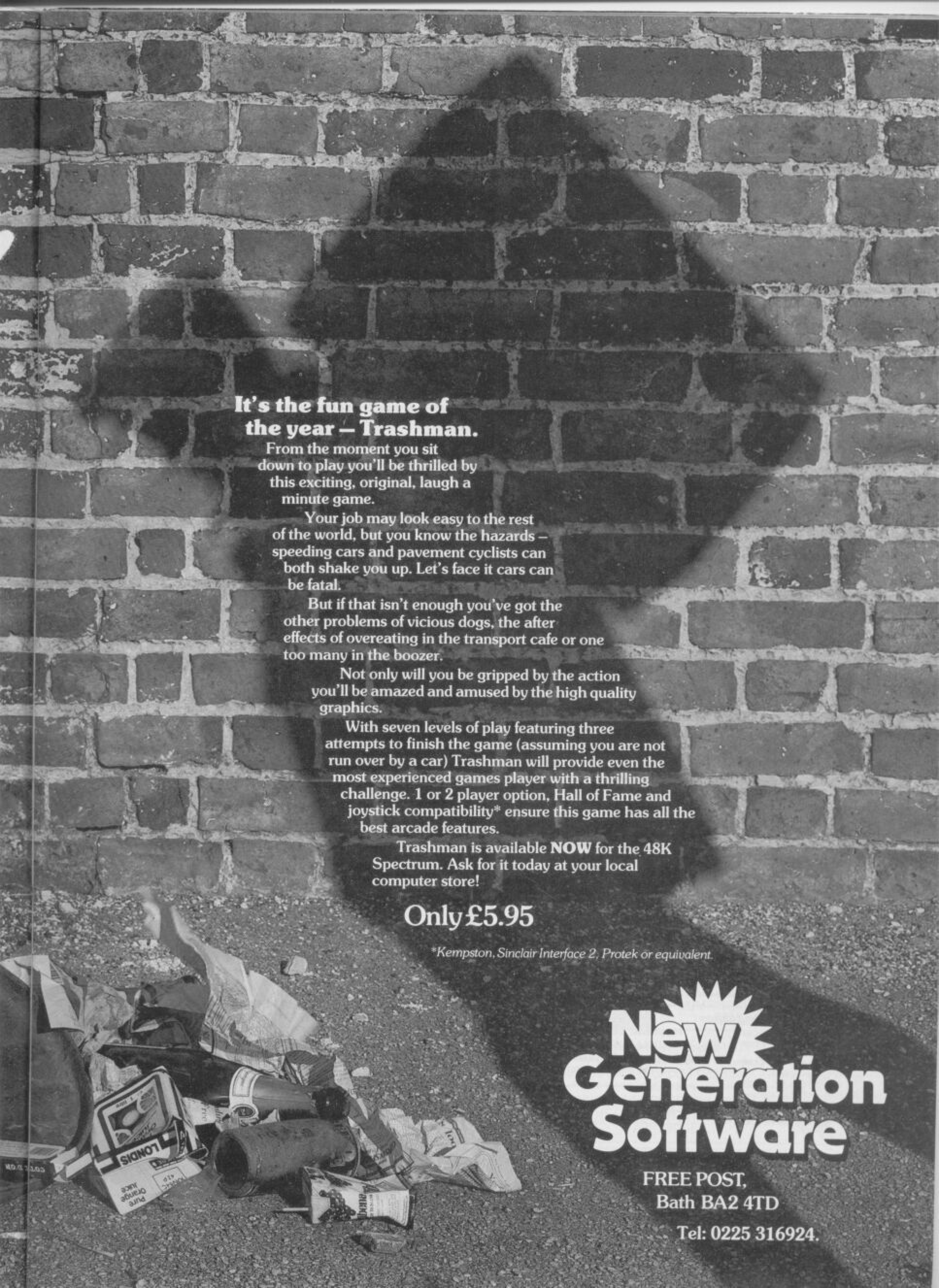
I'm not sure I knew what to expect on the first Wednesday after issue three hit the streets — would I have a flood of calls, or would the 'phone be dead? In the event the first day was pretty quiet, but the activity since then has certainly made up for it! The problems themselves have ranged from difficulties with programs listed in the mag, to agonies over broken Spectrums.

Mr Blackheath from Taunton had trouble with his keyboard. The keys from Caps Shift to Space had died on him — in other words he'd lost the whole of the bottom row. It's a fault that's caused by a cut or break in the keyboard membrane, usually where it enters the PCB connectors. You can either fix this problem yourself, by cutting back the connectors behind the break, or you can buy new membranes for £1.20 + VAT from CPC at 194-200 North Road, Preston, Lancashire, PR1 1YP. And for all those of you out there who have blown up your ULAs, CPC sells those as well — for £5.25 + VAT. Unfortunately, CPC imposes a minimum order charge of £5 + VAT in the UK, so in some cases you might have to buy a few other bits and pieces to make up the order.

John Hansen-Pryce, a Speccy owner from Woking in Surrey, asked about keyboards for his machine — a query that was echoed by many of our callers. Of the keyboards I have used, the Fuller FDS is one of my favourites; unfortunately though, the company's customer service leaves a lot to be desired. An alternative to the Fuller keyboard is Lo-Profile, a very nice device from a very nice company — AMS. This outfit has obviously spent a lot of time studying the market and has come up with a very good design.

Back to the more mundane problems, in issue two the programs listed in *Play Power* had a small problem. All the pound symbols (£) had been printed as backward separators ('), and all the hash symbols (#) had been printed as pound signs (£). Apologies to those readers who tried for hours to type in PRINT £1, and who also tried to find the backward separator character on the Speccy The lines are still open, on Wednesdays and Fridays from 10am till 1pm and 2-5pm. You can ask about anything to do with the Speccy or *YS*; don't expect me to know everything (*It's rumoured he's human! Ed.*), but I'll help if I can. YS


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Not only will you be gripped by the action you'll be amazed and amused by the high quality graphics.
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New Generation Software
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Tel: 0225 316924.

THE YS TOP 20

Here it is again, the Top Twenty that you *know* isn't fixed. Why? Because it accurately reflects *your* views on the software scene.

Another useless prize goes off again this month; three tapes are crawling their way towards David May of Chiswick, London W4 because our delightful Dep. Ed. pulled David's voting slip out of the bag.

Enter the draw *every* issue by filling in the form below (or a photocopy if you don't want a magazine full of holes), telling us what your latest raves for the Speccy are. We'll record your choices and enter your name for the prize. *Wowee*!

And don't forget about the all-time losers. Tell us the games you think are real turkeys and you just might get a software prize for that as well — ropey stuff, of course.

YS TOP 20 READER POLL

My top five raves on the Speccy are:

1 ____
2 ____
3 ____
4 ____
5 ____

My bottom three turkeys on the Speccy are:

1 ____
2 ____
3 ____

Yes, I'm convinced my vote is a major contribution to the Editor's insanity.
Stick in a pillar box as quick as pos', with your envelope addressed to:

YS TOP TWENTY
YOUR SPECTRUM
14 RATHBONE PLACE
LONDON W1P 1DE

YOUR SPECTRUM

TOP TWENTY CHART

THIS MONTH	LAST MONTH	MONTHS IN CHART	TITLE	DESCRIPTION
1	1	2	**JET SET WILLY** SOFTWARE PROJECTS	SEQUEL TO MANIC MINER. GO WITH WILLY INTO 60 MORE EXCITING LOCATIONS.
2	2	3	**MANIC MINER** SOFTWARE PROJECTS	JOIN MINER WILLY IN HIS QUEST FOR THE MISSING KEYS, IN 20 BIZARRE AND COLOURFUL CAVERNS.
3	8	2	**SCUBA DIVE** DURELL SOFTWARE	PUT ON YOUR WETSUIT AND PLUNGE INTO THE ICY DEPTHS IN SEARCH OF TREASURE.
4	6	3	**ATIC ATAC** ULTIMATE	A FULL GRAPHICAL ADVENTURE IN AN ARCADE FORMAT, BUT WATCH OUT FOR THE GHOSTS!
5	11	3	**LUNAR JETMAN** ULTIMATE	A COMPLEX ARCADE/ ADVENTURE THAT TAKES PLACE ON THE MOON.
6	4	2	**ANT ATTACK** QUICKSILVA	AN AMAZING 3D ADVENTURE IN THE CITY OF ANTESCHER THAT HAS YOU RESCUING YOUR DUMB MATE FROM KILLER ANTS.
7	9	3	**CHEQUERED FLAG** PSION	JOIN THE GRAND PRIX CIRCUIT AND RACE SOME OF THE GREATEST TRACKS IN THE WORLD.
8	5	3	**FIGHTER PILOT** DIGITAL INTEGRATION	A 3D FLIGHT SIMULATION PROGRAM THAT SITS YOU BEHIND THE CONTROLS OF A FIGHTER PLANE.
9	3	3	**DEATHCHASE** MICROMEGA	REMEMBER THE 'BIKE CHASE' SCENE FROM RETURN OF THE JEDI? ALL HAS BEEN RECREATED . . .
10	–	1	**WHEELIE** MICROSPHERE	A LIFE-OR-DEATH RACE AGAINST DOUBLE-DECKER BUSES AND MANIC HEDGEHOGS.
11	19	2	**THE HOBBIT** MELBOURNE HOUSE	BASED ON THE BOOK BY TOLKIEN. YOU TAKE THE PART OF BILBO BAGGINS IN SEARCH OF DRAGON'S TREASURE.
12	20	3	**ALCHEMIST** IMAGINE	A WIZARD PROGRAM WHICH MANAGES TO BLUR THE BORDERS BETWEEN ADVENTURE AND ARCADE.
13	7	3	**JET PAC** ULTIMATE	BUILD A SPACESHIP, THEN TREK THE GALAXY FOR RARE GEMS AND TREASURES.
14	14	3	**PYRAMID** FANTASY	THERE ARE 120 COLOURFUL ROOMS, AND ALL YOU HAVE TO DO IS COLLECT THE CRYSTALS — THE TROUBLE IS IT'S RAINING ALIENS!
15	–	1	**FRED** QUICKSILVA	YOU TAKE THE ROLE OF AN ARACHEOLOGIST LOOKING FOR TREASURE IN AN OLD MINE-MAZE.
16	13	3	**HUNCHBACK** OCEAN	A FAST-MOVING ARCADE CONVERSION JUMPING THE WALLS TO SAVE ESMERELDA.
17	–	1	**NIGHT GUNNER** DIGITAL INTEGRATION	ORIGINALLY ON THE ZX81, THIS HAS ALREADY PROVED ITSELF AS A FAST-MOVING ARCADE-TYPE SIMULATION.
18	–	1	**FLIGHT SIMULATION** PSION	ORIGINAL FLIGHT SIMULATION FOR THE SPECCY BY WHICH OTHERS ARE JUDGED.
19	–	1	**HARRIER ATTACK** MARTECH/DURELL	ATTACK THE OCCUPANTS OF A SMALL ISLAND WITH THE VALIANT LADS OF THE HARRIER DIVISION.
20	10	2	**CHUCKIE EGG** A & F SOFTWARE	FARMER GILES HAS TO ROUND UP ALL THE EGGS BEFORE THE NASTIES GET OUT AND EAT UP ALL THE CORN.

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NEW

INTERFACE E – ONLY £55.00
Simply plug in and it's ready to use. All operating commands are held in an EPROM so LLIST, LPRINT and COPY can be used at any time without using up valuable user RAM. COPY will allow the reproduction of high resolution graphics with Epson (or derivatives) and Seikosha 80, 100 and 250 Series printers. Print width selection from 32 characters to full width depending on printer used.

INTERFACE S – ONLY £39.99
Visually identical to Interface E but without the EPROM, Interface S also recognises the LLIST & LPRINT commands and will allow print width selection from 32 characters to full width.

However, software routines will need to be loaded before use. Full screen dump to reproduce high resolution graphics is also possible and supporting software is supplied to operate this facility with Epson and Seikosha printers. The software routines that are necessary to initialise the interface are held in the printer buffer so valuable user RAM will not be used up. There is a growing range of Business/Utility software that includes these routines. Details available on request.

Either interface simply plugs into the ZX Spectrum expansion port or interface and is supplied fully cased with a one metre ribbon cable which connects to the printer of your choice. Full instructions are included and driving software is supplied with Interface S.

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FORUM

Is there something you're not telling us? Write in to Forum, *Your Spectrum*, Rathbone Place, London W1P 1DE.

SOME QL THEORY...

With regard to Andrew Pennell's interesting article on SuperBasic, the provisional documentation seems to indicate that only variables are allowed in SELect, so in Listing 2a you would need to write:

```
1045 LET charcode = CODE a$
1050 SELect ON charcode
1060 ON charcode = 13
```

And so on. SELect actually is not new; it's been part of the draft ANSI Basic standard for some time and at least one version (for Honeywell Level 66 computers) is now generally available. The ANSI SELect can handle both numbers and strings and allows you to put expressions on SELect statements.

Regarding procedures, PROC (thankfully, unlike BBC Basic) may and indeed should be separate from the procedure name, so line 1000 in Listing 4a should be:

```
1000 DEFine PROCedure pformat (b)
```

Examples of calling pformat are:

```
pformat (34.65)
pformat principle+interest
```

Dr Nigel Brown, Pisgah Research, Dyfed

...AND QL PRACTICE

I'd like to tell you about the Independent QL User's Group that Brian Pain and I have formed. Besides being Acting Chairman of the group, I edit *Quanta*, the group's newsletter, three issues of which have been produced to date.

Membership of the group is by subscription to the newsletter (currently £4.25 for six issues). The contact is Brian Pain, Acting Secretary to the group, who can be reached on (0908) 564271. His address is: 24 Oxford St, Stony Stratford, Milton Keynes, Bucks.

Leon Heller, Newport Pagnell

MONITORING THE SITUATION

Referring to your article in *YS* issue 2 about monitor connections for the Spectrum, I did this on my issue 2 machine some time ago and, although it worked, I got a grainy picture. This was cured by connecting a further link between the two points provided below the capacitor on the top edge of the board by the modulator. This links up an earth path round the edge of the board and has resulted in a tremendous improvement in the display of all the issue 2s I've tried it on.

The places to be linked can also be found by two solder 'pads' in the holes on the board.

David Oram, Liversedge

MICRODRIVING

I'm putting my money where my mouth is and have cancelled my order for another well-known magazine which supposedly caters for Sinclair users but which is in fact full of listings suitable for five-year olds (no disrespect to that age group) and free advertising in the form of 'news' without commentary on the merits of the products (usually including telephone numbers and addresses for the unwary). Beware: I am watching. My order is now for *YS*.

The main point of this letter is the rights of users (after all, we've heard plenty about software houses trying to protect themselves). Tasman is one of the few far-sighted software houses that assists its customers in using the hardware they own to the full, and Campbell Systems is another. They not only encourage and facilitate the making of back-up copies of one's own valuable software but also, by providing useful notes, allow you to use your Microdrives as you intended them to be used when you ordered them.

Of course, software houses have the right to protect their interests as far as commercial piracy goes, but their customers also have rights. Sophisticated protection methods seem to positively encourage copying as it provides the user with a challenge. Once the protection system is beaten, it's only human nature to show off one's cleverness by handing out copies. Tasman and Campbell Systems don't seem to be suffering.

Having spent a fortune on software — probably more than on my hardware — I have the right to use that software as I deem best. I don't wish to make money by copying and selling pirated software (the law of the land should cater for that), but I *do* want to load software in seconds not fractions of an hour.

I'd like to point out that, while software is often not immediately compatible (and I'd encourage magazines to comment on compatibility in reviews) — there's virtually no software anywhere that cannot be transferred in spite of the efforts of software houses and the thoughtlessness of Sinclair Research.

John Ashplant, Enfield

JUST INTERRUPTING

Your readers may be interested in my method of implementing interrupt mode 2 routines. If the I register is loaded with 19H, the interrupt vectors jump to the routine at address 5D22H, which is a short distance in to what is normally the Basic program area.

By calling the ROM MAKE_ROOM routine at 1655H with the HL registers holding 5CCAH and the BC register pair holding the number of bytes required, space can be provided in memory between the channel information and the start of Basic.

I loaded a few toolkit routines which I've written into this area and have now incorporated Ian Turtle's clock routine at address 5D22H.

The MAKE_ROOM routine also works in the Microdrive maps area although it's then also necessary to increment the CHANS systems variable because the routine only changes pointers down to PROG. If Microdrives are used, then additional channel information is defined and this will have to be considered when using these areas for machine code.

Alan Rooney, Stockport

ISUG LIVES!

We have heard it said, yet again, that there's no international organisation dedicated to the Sinclair Research range of computers.

May we point out that this is definitely *not* the case! The International Sinclair User Group was formed in August '83 following the closure of Tim Hartnell's National ZX User Group. It's grown steadily since then, and now boasts members in the UK, Eire, Holland, Germany, Spain, Malta, Saudi Arabia, Malaysia, Singapore and Australia. The age range of our membership is from 11 to 71 years, both male and female.

Membership of ISUG brings a monthly newsletter entitled *ZX Press* and a discount of 20 per cent on a very large range of software, as well as contact with other ZX users around the world.

New members are always welcome, whether you are an accomplished programmer, a complete beginner or just 'play around' now and again and would like to learn more. If you'd like further details, drop us a line at ISUG, 189 Rosehill Road, Burnley, Lancs. BB11 2QX.

Vic Webber, ISUG

YOUR FULLER PROBLEMS

I was delighted to see that Fuller is not having problems (issue 3, Frontlines). However, on the strength of the article I decided to try again with this much-maligned company. My first attempt to obtain an FDS keyboard and buffer began in November 1983, when my telephone order was duly taken with credit card number for payment. Christmas came and went, and in mid-January 1984 I tried again and again to make contact. I eventually got through, to be told my order was being dispatched *tomorrow*! The next week I got through again and was told it had definitely been despatched — but if it hadn't, they would send another. In late February after a repeat of this information I managed to speak to someone who informed me that there had been a mistake in the orders (only natural with such a common surname as mine), and my order was given again. This time I was

informed that credit cards were not acceptable and the buffer was not then available — no order was given.

Today I tried again, ringing the number in your newspiece and their advertisement in the same issue, only to be told that the number is now 051-709 9280. When I eventually got through I was told the keyboard was in stock but the buffer was not and, when pressed, they told me it might be 'two or three weeks'. I was also informed that only Access cards were accepted, and those only in orders sent by post.

I trust that this information will be helpful to those still inclined to do business with this company. I am certainly no longer one of them.

CG Lundgren, Nottingham

GROCKLES HELP OUT

Please (*on your knees, scum. Ed.*) give our club a mention in '*Your Speccy*'.

Meetings are held in the Roche Co-op rooms twice a week: Monday 7-10pm and Friday 7-9pm. Cost of membership is a meagre £1.20 a year.

Mr M Richard, Roche, Cornwall. Tel: (0726) 890473

JUST A NIBBLE

Why is it all you computer buffs seem to have forgotten the days when you'd never RANDomised a USR and a byte sounded like your next meal?

I must admit that Toni Baker's article in your first issue aroused a faint hope that all was not lost — she actually *explained* what was happening *and* what we had to do! But alack and alas, you've gone all top-lofty on us.

My cupboard is LOADed with tapes; some are games (half of which don't work), and some are utilities (half of which I don't know *how* to work).

Take the tantalising article by Andrew Pennell in your second issue, 'Those Moody Microdrives'. Being the proud owner of such a beast and unable to save certain machine code programs on it, I leapt joyfully into action with this wonderful cure-all. But stay, should I LOAD it, RUN it then NEW it before LOADing my program? No joy there — all the bytes for the magical cure-all had magically vanished! Try again. LOAD it, RUN it, and then painstakingly remove all the Basic line-by-line from the magical cure-all. Eureka! The bytes remain. Now RAND USR at + 41, load unhappy program — nothing. Oh, of course, the program uses the address st + 41 itself, so I'll put the cure-all at a higher address. Should I CLEAR first? Lud, I don't know. Whatever! The thing still didn't work.

Please could you treat us like a bunch of idiots and guide us patiently (or am I the only fool?)

Miss J Wood, Altrincham

Although the mag is aimed at the experienced user, we do try to make it accessible for the beginner. If you want to move the routine to a higher address, change the value of st in line 10 and CLEAR at st-1; mind you, if your code CLEARs lower than that, you don't need to CLEAR at all. What can I say to your last question — apart from 'No comment!'. Troubleshooting Pete.



When your magazine first appeared I was pleased that it seemed to be pointed at a more intelligent (and older?) set of readers than other magazines. So I feel very irritated at the use of the word 'Speccy' frequently throughout the text. I wish, Mr Editor, you would instruct your sub-editors to search and replace the word with something less juvenile.

EG Matthews, Dorset.

How about the Sinclair Research Z80-based automatic electronic apparatus for making calculations or controlling operations that are expressible in numerical or logical terms? (Nah, not long enough. Ed.) (I vas jus' followin' instructions. Sub Ed.)

IS THIS MAN ILL?

I've always been slightly nauseated by the abundance of 'Your magazine is wonderful'-type letters so often found in other computer publications. What sort of creep would make the effort of sitting down, writing such wet compliments and then wasting 16p to mail it?

Then, like Hercule Poirot in the penultimate chapter, it dawned on me. There was an ulterior motive behind all the 'to-the-skies' type praise I kept reading — MONEY! '£10 for every letter printed' it said at the top of the page, and there lay the answer. The most complimentary correspondence won the cash and all the other letters were thrown in the bin. Quite a good scheme really, considering how totally knowledgeless their resident 'experts' are. Even the dumbest questions, like 'Where do Atari cartridges plug into my ZX81?' and 'Why does my Spectrum keep printing funny messages at the bottom of the screen when I turn it on?' are ineptly answered.

Having said all that you can imagine my horror when I started to read your magazine — because I found myself wanting to write telling you how good it is. I wanted to say how I liked seeing a magazine totally devoted to my machine — without the other 90 per cent for the BBC, Commie 64, VIC 20, Dragon, ZX81, and MTX that the other leading brands offer. Didn't I like seeing simple, unbiased software reviews, showing actual colour screen photos of every game? *Sinclair User* says everything is fantastic and shows unrelated drawing of the action, whereas *Your Computer* only features two or three games and their reviewers are too keen on witty comments to put across a sensible evaluation. In your magazine I soon discovered that I agreed with your view of games I'd seen and could therefore trust what you said about the ones I hadn't.

I wanted to say how I liked your 'Misfires' article. Yes there is a lot of rubbish on the market and we *should* be warned.

Basically, I wanted to write you a complimentary letter and thus join the group of insecure creeps I'd grown to loath in the other magazines. So I did, and this is it. Your magazine is the best around for the Spectrum user.

I do have one quibble, however, if you made it more clear how prospective contributions should be sent to you I think you'd be inundated with programs and such. For example, would a cassette suffice and would I get it back? Do you want a printout? Will you pay me? How much? These questions are important.

I almost wrote out a cheque for your ZIP Compiler but changed my mind at the last minute. It wasn't clear in the article — which was incidentally very easy to understand — whether the compiled code would run independently of the ZIP program. I already have the PSS MCoder compiler and this is one of the main problems I have encountered. Does it produce *bona fide* machine code or just cleverly engineered jumps to ROM routines? Having shelled out £10 for my other compiler, I'm now very wary. (*Simon G will be writing to you – Ed.*)

As my letter draws to a close, I realise that it is now probably too long to print anyway. A shame really since I longed to see my name on your pages. Thank you again for a good magazine, I shall look forward to the next issue with anticipation.

James Reid, Reading

We'd love to see your programs, cassettes, Microdrive cartridges, articles, and anything else you'd like to send us (plain wrapper please). After an arm-twisting session, our accountant has been known to make generous contributions to people's finances — but the material has got to be good! Was that an inept enough answer for you? Ed. (By the way, your cheque's in the post.)

AS YOU WEREN'T

On looking through issues 1 and 2 of *YS*, I notice in issue 2 that you apologised for mixing up the screen shots of *Velnor's Lair* and *3D Strategy* in issue 1.

I don't know about *3D Strategy* but the *Velnor's Lair* display is alright! By the way I offer 10p.

Roy Stead, (author of The Domain of Epsilon), Cheshire

10P!!?! What are you — made of money? We wouldn't take a penny more than 5p. Ed. YS

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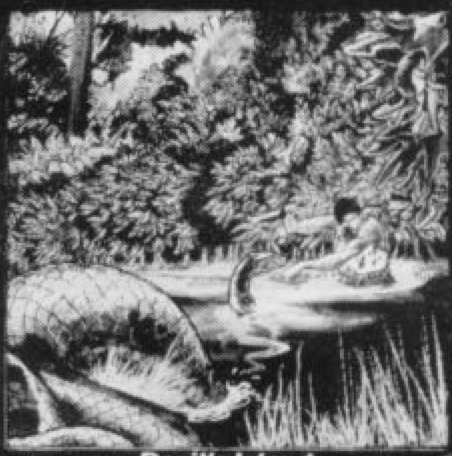
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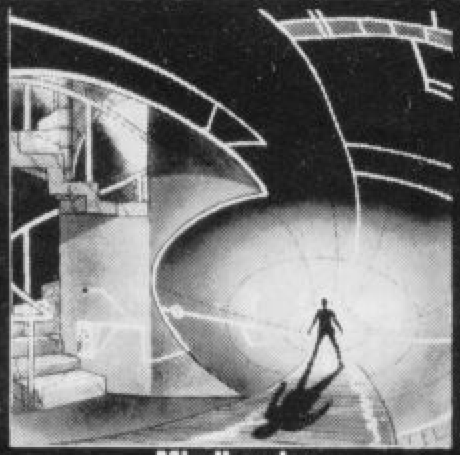
Devil's Island

Escape from the infamous prison maybe impossible, but what alternative have you?



Spyplane

Can you survive and complete your mission high in the sky over enemy territory?



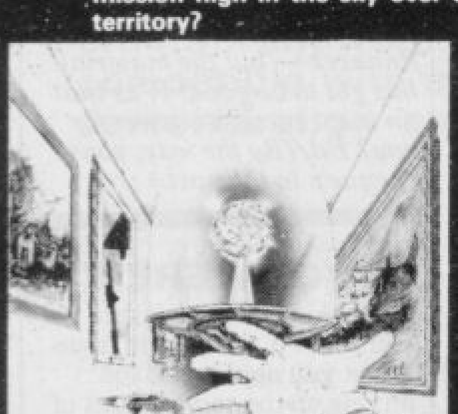
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CHANNELS AND STREAMS

YS*'s own Mr Fix-it, *Ian Beardsmore*, guides you through the rapids of channels and streams. For theory, philosophy, bugs and fixes — write to *Ian* c/o *Spectrolysis, Your Spectrum, 14 Rathbone Place, London W1P 1DE.

"Open Channel D." And with that Napoleon Solo and Ilya Whatshisname go steaming into another exciting adventure. Those of you in the over twenty-five bathchair brigade will recognise the *Man From Uncle* television series as the source of this famous quote. As for those of you too young to remember the series, well. . .why worry. After all, you have an all-singing, all-dancing Speccy computer — and yes, you too can "Open Channel D" — well, '4' actually. Or can you?

CHANNELLING CONFUSION

In fact, channels and streams seem to be the cause of a disproportionate amount of confusion — certainly they seem misunderstood and misrepresented. Many people have been disappointed that simply entering OPEN #4 doesn't give them a new channel. Perhaps one major reason for this is the fact that all the '#' commands are, in fact, stream commands! Despite various attempts to explain what actually happens, this is a commonly held and quite fundamental misunderstanding.

At its simplest, a channel is a routine (or suite of routines) in machine code. A stream is the path by which the channel is joined to or is accessed by the user in Basic. Perhaps the first thing that needs clarifying is the relationship between the channel and the hardware peripheral with which it's commonly associated. This is certainly the place where channels were intended for use by Sinclair Research, but what's that got to do with it? *Your Spectrum* wouldn't exist if the Speccy was only used for what it was intended. Anyway, of the three channels we can use on the normal Spectrum minus Interface 1, all are hardware orientated (dealing as they do with the upper and lower screen and the printer). It's interesting that the one you can't get at deals with creating workspace.

This use of a channel to access workspace routines is a giveaway to the true nature of streams and channels. In the other three cases it's often said that somehow that channel is the printer — it's not. Instead, in the case of Channel 3 for example, it's the suite of routines that control the printer. The same idea applies to the two-screen area, where instead we are dealing with display routines. Perhaps somewhere down in the deep inky-blackness of your minds, a vague glimmer of awareness is starting to develop. Can streams and channels be used to access your own machine code routines? After all, it does seem as though streams and channels are used to place machine code between Basic and a peripheral? Why indeed? And yes, this is where channels and streams do come into their own.

BACK TO BASICS

Now is the time when those who are impatient to rush to their computers and after a quick glance at the manual, smugly begin POKEing the RAM — so as to extend the channel area. After that, a quick trip into the stream data and . . . Bob's your uncle. Only he isn't! If only you could get rid of those pesky error codes, and if only the predefined channel specifiers worked. Sadly, you're stuck with playing around with the lower screen, upper screen and printer; and of course, not being a noddy user, you want the thing to point to your own routines, not those of the ROM. Now that you've calmed down I have to tell you that setting up a new channel can only be done from machine code.

Just as a reference try 10 OPEN #2, "P". RUN this and then try to PRINT something. It prints on the printer, not the screen. So what use are such silly games? Well, just to point out that the '#' commands really do only recognise certain specifiers in Basic.

As long as you stick to what the computer gives you, then you can open every stream and channel, except that they'll be the same. Another aspect of channels is that they can be used to send data in both directions — and the fact we can play silly games actually belies the real potential of using channels. It really is useful to keep in mind that a channel is a set of routines and not a peripheral as such — and a stream is just a path. Its performance lies in the fact that it simply goes from one place to another. No controls are needed; all that has to be done is for the route to be attached to its destination.

Try entering the example program (which if you look closely gives you a two-for-one bargain). It is very simple, just a series of PEEKs into the STRMS area and the CHANS area. However, you'll probably find the information very useful because it shows clearly how Sinclair Research uses streams and channels. One note, however — you should get your address for the start of the channels area by PEEKing the systems variable. I've used a Spectrum without the interface and gone straight in with the start address. Please remember to do as I say, not as I do. By the way,

The Streams And Channels Routine

```
   2 REM STREAMS
   3
   4 LET V=-3
   6 PRINT " #  L byte      H Byte      OF
FSET"; PRINT "   addr  val  addr   val
(addr)"
   7 PRINT
  10 FOR w=1 TO 38 STEP 2
  20 LET a=23567+w
  30 LET b=a+1
  40 IF v>-1 AND v<10 THEN  PRINT ;" ";
  50 PRINT v;TAB 4;a;" ";PEEK a;: PRINT
TAB 15;b;"  ";PEEK b;
  60 PRINT TAB 27;PEEK a+PEEK b*256
  65 LET v=v+1
  70 NEXT w
 100 STOP
 120
 130 REM CHANNELS
 140
 200 LET a=23734
 300 FOR y=1 TO 4
 400 FOR z=1 TO 2
 450 LET b=a+1
 500 PRINT a;" ";PEEK a;TAB 11;: PRINT b
;" ";PEEK b;
 550 PRINT TAB 22;PEEK a+PEEK b*256
 600 LET a=a+2
 700 NEXT z
 800 PRINT a;" ";PEEK a;"  -";CHR$ PEEK
a;"-"
 900 LET a=a+1
 950 PRINT
1000 NEXT y
1100 PRINT a;" ";PEEK a
1300 STOP
```

Printout From The Streams Program

#	L byte addr	L byte val	H Byte addr	H Byte val	OFFSET (addr)
-3	23568	1	23569	0	1
-2	23570	6	23571	0	6
-1	23572	11	23573	0	11
0	23574	1	23575	0	1
1	23576	1	23577	0	1
2	23578	16	23579	0	16
3	23580	16	23581	0	16
4	23582	0	23583	0	0
5	23584	0	23585	0	0
6	23586	0	23587	0	0
7	23588	0	23589	0	0
8	23590	0	23591	0	0
9	23592	0	23593	0	0
10	23594	0	23595	0	0
11	23596	0	23597	0	0
12	23598	0	23599	0	0
13	23600	0	23601	0	0
14	23602	0	23603	0	0
15	23604	0	23605	0	0

Printout From The Channels Program

```
23734 0      23735 240   61440
23736 1      23737 33    8449
23738 239    - LOAD -

23739 28     23740 205   52508
23741 123    23742 0     123
23743 34     -"-

23744 186    23745 92    23738
23746 201    23747 12    3273
23748 0   -?-

23749 1      23750 0     1
23751 0      23752 0     0
23753 80   -P-

23754 128
```

CHANNELS AND STREAMS

the two programs are separate and I've just put them together for convenience.

STREAMLINED SOFTWARE

The first STREAMS program gives a breakdown of the 38 bytes that hold the offset addresses for attaching the streams to channels. This offset number is all-important. Stream 2, for example, is for the normal screen display and a glance at the second printout will show that the screen channel data starts at the sixth byte. Surprise, surprise, the offset number for the second stream is '6'. If we were to change this, for example to 16, then Stream 2 would address the printer channel. In effect this is what you were doing when you entered OPEN#2, "P" earlier — attaching Stream 2 to the printer channel. Anything on that stream will then go to the printer. From here you can see that to open Stream 4 and attach it to Channel 4, address 23582 in the stream data will have to carry 21. This, when added to the base address of the CHANS area, will give you the first byte of the data related to Channel 4 — in our case 23754. At the moment this is holding 128, which is the end marker byte for the CHANS area.

The printout alongside shows just how much can be stored in a set-up like this. Of the five bytes allocated to each channel, the first two are the address of the 'Output' routine, the next two the 'Input' routine and the last byte is the specifier. Even if the specifier is not a true description of what the channel is, it'll still have to be there. Again like the streams in the previous paragraph, inserting your own address is far more than a question of simply POKEing, and I'd advise you to take great care you don't overwrite the Spectrum's own routines. It strikes me as one of the annoying quirks that channels cannot be extended from Basic. Perhaps Sinclair Research wanted to keep down the amount of access that the average user could gain of outside devices — a pity.

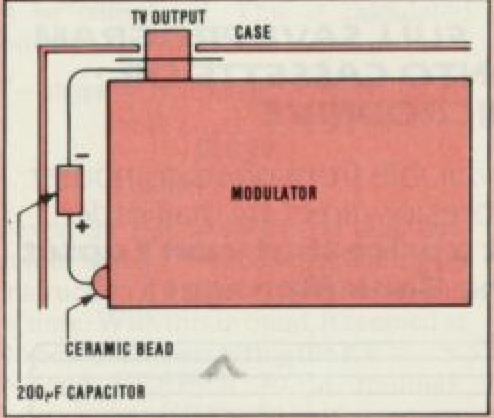
In point of fact more than one routine is needed if the new channel is to be opened and used. Besides the routine to actually link the new stream with the new channel, you need to open a space to store the necessary data of the new channel. There's no point going to these lengths if there's no 'Input' or 'Output' routine to be addressed — without these the path to wonderland is useless. By next month I hope to have all that sorted, along with a suitable listing for you. But for those getting impatient, here's a brief run through of the code you need to do the job.

First, HL and BC need to be loaded with the base value of the CHANS variable and the offset respectively. With this you can call the Spectrum's own ROM routine CALL 1655 (Hex). This is a 'make room' routine and it'll be used to create the extra space for the channel data. Coming out of this, HL is holding the address of the start of the new space, and BC the end; swop them around. Use HL to load in the various values you want in the five bytes (remember that you start with the specifier at the highest address). Lastly comes what's probably the trickiest part of the job. Although you've managed to set up your new channel, at the moment it's in limbo with no stream connecting it. It means being careful not to lose the offset while you set up the string. The one advantage is that at least it's a single byte number, and the best bit is that, when this last section of code has been completed, that's it; you can now open a stream to your new channel. Just what the new channel will do is another subject — or perhaps I should say, other subjects. Any ideas? VS

MORE TUNING

C R Hall from Mill Hill, London NW7 has written about the 'Tuning-up' article. He says it works fine, and goes on to disclose a piece of information about the BBC Micro (excuse the bad language) showing a 10pF capacitor wired from the modulator to a nearby resistor. He wants to know if the same can be done on a Speccy.

The answer is 'yes', though the detail is different. On the Spectrum you need a 200μF capacitor wired between the case of the output socket and the earth point on the modulator. The earth point is the wire coming out of the modulator nearest the back and identified by the brown ceramic lead (see diagram).



HAVOC

Digging around some time ago, I came across this little routine. It's rather fun — fun, that is, if you get kicks from wrecking the displays of Spectrums in your local WH Smiths, or causing GBH to migraine sufferers.

Enter as a direct command:

```
CLEAR 64000
```

Follow this with another direct command:

```
POKE 64001,66
```

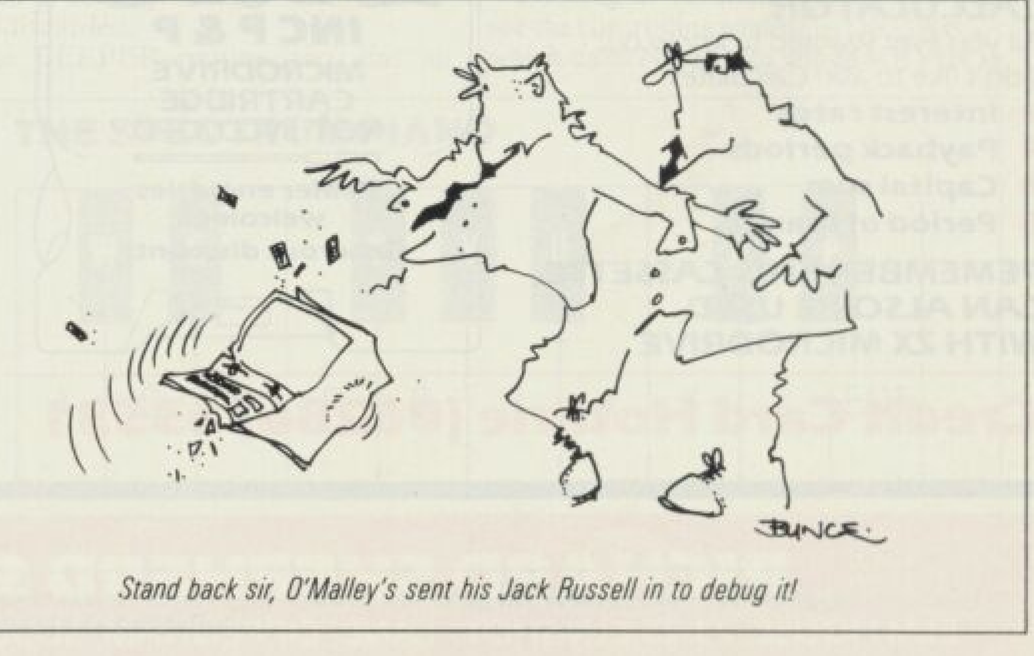
Nothing spectacular so far, but a line is needed. Enter:

```
110 CLOSE # 4
```

and then RUN it. You now have 23.4 seconds of blank screen in which to make yourself scarce.

There seem to be several interesting oddities, and so far no other CLEAR number I have found works — though I suspect there are some which I've not had a chance of looking into at the time of writing. One thing, the number POKEd into 64001 is important (which caused some initial surprise). Other numbers you could use are 3,5,80 and 168, though I was amazed when some numbers in the 60s failed to work and just caused a complete crash, minus the pretty effects.

Having blatantly pandered to the intellect of my readers already this month, I'll not insult your intelligence by telling you the common factor of these values. Nevertheless, I hope to have more on this for you next month, either as a product of my own grey matter, or of yours.



Stand back sir, O'Malley's sent his Jack Russell in to debug it!

SPECTRUM CONTROL

PROJECT TWO REVISITED

The second project (issue 2 of *YS*) in our *Spectrum Control* series set a particularly difficult problem that was all about using the Spectrum as an electronic organ. The nub of the idea was to generate a note whose duration varies in relation to the length of time a key is held down. The standard BEEP routine is not suited to this purpose, because it requires the duration of a note to be specified in advance. And even if it was possible to overcome this hurdle, how well would the keyboard scanning routine perform?

All this and more has been carefully considered by *YS* reader, Christopher Ashford, who sent us a detailed explanation of his method, and complete program listings to boot. For reasons explained in the text that follows, Mr Ashford decided the only approach was to set about writing his own routines. Exactly how he did this and also how he defined the problem, are all clearly explained. We also get some meaty tips on how to muck around with the program to produce some interesting, if not altogether desirable, results.

YS *reader,* Christopher Ashford, *claims this is your chance to become a machine code musician.* Penny Page *puts it to the test . . .*

PROBLEM DEFINITION

As with any programming task, the first thing to do is define the problem both as simply and as briefly as possible. In this case we need the loudspeaker to be turned on and off at a frequency corresponding to one of the keys — for as long as that key is pressed (see the *Frequency Table*).

Now, looking at the diagram depicting the piano, we can see how the Speccy's keys represent those you'll find on a normal piano keyboard. The note, in order to be 'clean', must have an equal ratio between loudspeaker ON and loudspeaker OFF; ie. a one to one mark/space ratio. This approach is best illustrated in diagramatic form, showing the five states of the Spectrum during each half-cycle period.

MAKING IT HAPPEN

By varying the length of stage 4, according to the key pressed, each half-cycle time can be controlled exactly. Stages 1,2,3 and 5 must all be executed within the half-cycle time of the highest frequency, so as to properly meet the requirements of the problem. Knowing that the highest frequency required is 659.26Hz(=fmax) and the speed of the Spectrum's clock is 3.5MHz(=fs), we can work out the number of clock cycles (T-states) in which sections 1,2,3 and 5 must be completed. This is calculated as follows:

$$\text{T—states} = \tfrac{1}{2}(\text{fs}/\text{fmax})$$
$$= \tfrac{1}{2} \times \frac{1}{659.26} \times 3.5 \times 10^6$$
$$= 2654 \text{ T-states}$$

However, as Z80 instructions take between four and 23 T-states (depending on the instruction), it's quite possible to run out of time. With this in mind, it seemed at first to be worth considering the KEY_SCAN and BEEPER ROM routines. Unfortunately, KEY_SCAN is overlong, and its length also changes when two keys are pressed simultaneously — which makes its use highly undesirable. Bearing in mind the ease with which a more efficient block of Assembler code could be written to do the job, KEY_SCAN was soon discarded.

The BEEPER routine, too, has an inherent problem which renders it useless for this application. The minimum duration of a particular note is one whole cycle; using BEEPER would result in a distorted note, since the mark/space ratio would no longer be one to one. (A diagram is provided illustrating the distortion resulting from use being made of the BEEPER routine.)

CUSTOM BEEP

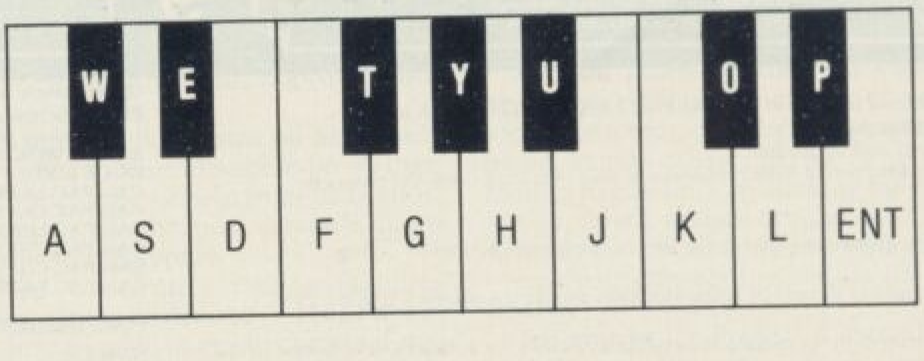
The solution to the problem is to write a customised BEEP routine, and this must be loaded in the upper 32K of RAM (48K Spectrums only). Since the RAM from 4000 to 7FFF is used by the ULA as well as the CPU, and also because of the hardware arbitration for access to this memory, it's impossible to precisely define a timing loop in this area. The Assembler routines in this solution start at 9000 Hex, and the memory map shown gives their addresses and organisation.

Looking at our memory map, we can see the controlling routine — ORGAN — which calls NOTE (in which KEYIN is

THE FREQUENCY TABLE

KEY	FREQ (Hz)	NOTE
A	261.63	C
W	277.18	C
S	293.66	D
E	311.13	D
D	329.63	E
F	349.23	F
T	369.99	F
G	392.00	G
Y	415.30	G
H	440.00	A
U	466.16	A
J	493.88	B
K	523.26	C
O	554.36	C
L	587.32	D
P	622.26	D
ENTER	659.26	E

THE SPECTRUM PIANO



A graphic representation of a piano, showing the relevant keys of the Spectrum used to simulate its operation.

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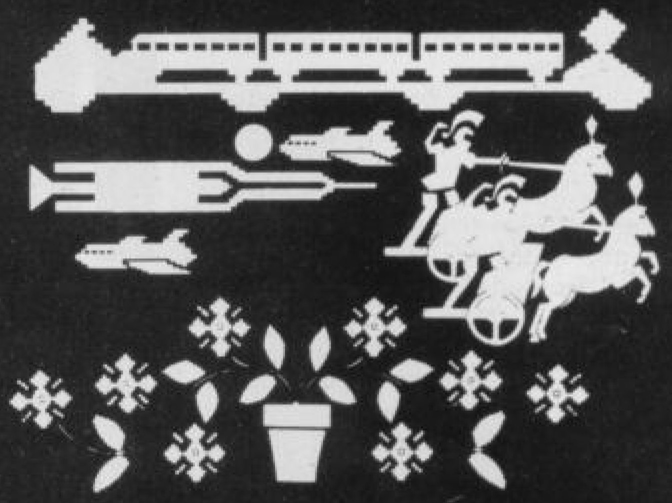
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CALPAC LEARNING SERIES — ZX SPECTRUM VOL. 2

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PROGRAMS 5-8



5 MULTIPLICATION TABLES
6 THE ROMANS
7 SPELLING TESTER
8 HOMOPHONES

SPECTRUM 16K 48K
FROM 7 YEARS

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12. LONG DIVISION. This detailed program takes the learner through long division sums in easy stages. Correction sequences are automatically provided when they are needed. Sums with remainders can be chosen if required.

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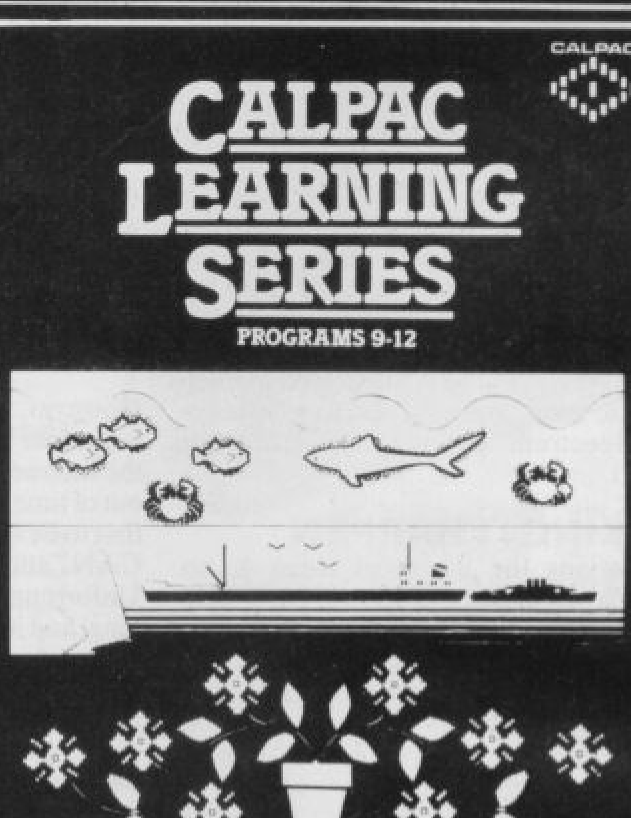
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PROGRAMS 9-12



9 NOUNS, VERBS, ADJECTIVES AND ADVERBS
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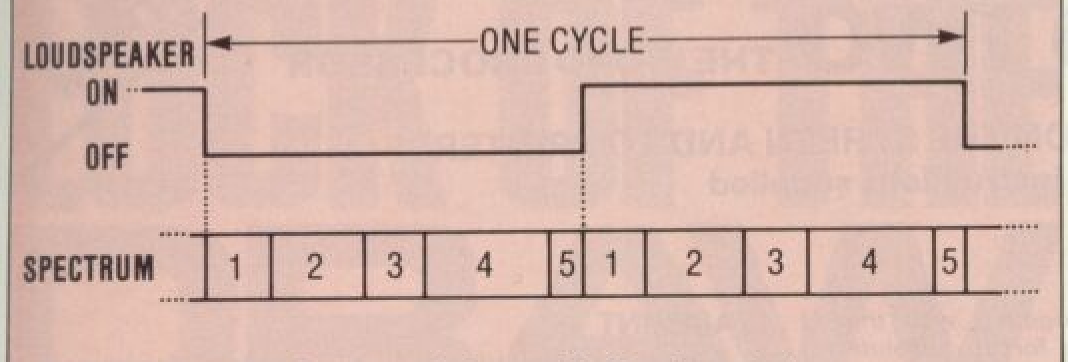
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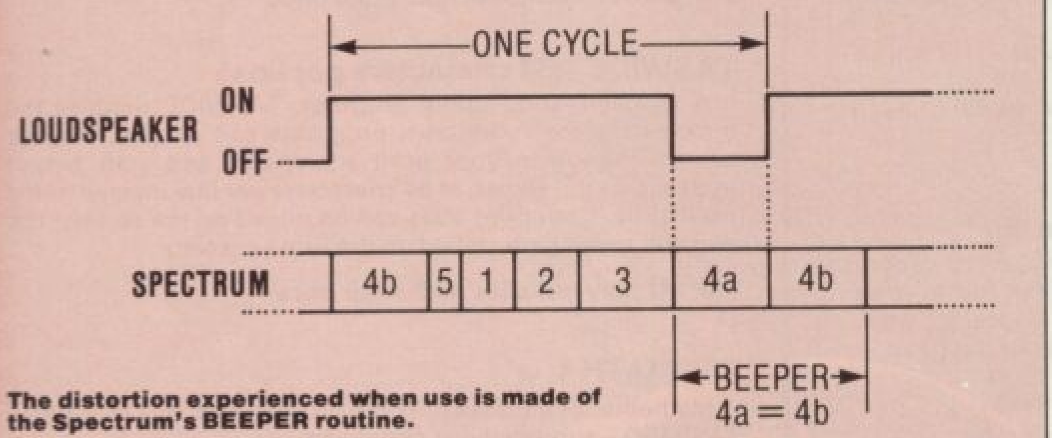
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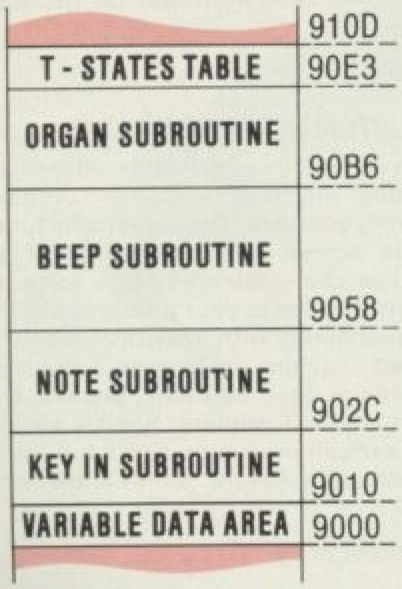


The five states of the Spectrum during each half-cycle period.

1. Read keyboard 2. Process keyboard information 3. Set up a timing loop 4. Execute timing loop 5. Toggle loudspeaker output



The distortion experienced when use is made of the Spectrum's BEEPER routine.



The memory map showing where the customised routine is addressed and how it is organised.

nested), and this updates the value of a pointer — the value of which depends on the key being pressed. This pointer is then used to access the relevant entry in a table of T-states required for each note; this number of T-states is passed to BEEP, which executes a precise timing loop. ORGAN can be called from Basic using:

RANDOMIZE USR 37046

And returns to Basic if Caps Shift and the zero key are pressed simultaneously.

With the Basic program, which automatically loads the code and calls ORGAN, it's possible to load a test value for the 'Q' key, so that other numbers of T-states can be played around with if desired. In fact, this program was used to tune the higher frequencies by ear, because although the number of T-states that were required for stages 1,2,3 and 5 were worked out mathematically (2509), something must have gone a bit wrong — the notes tended to sound a little sharp. Eventually, 61 was added to each of the five highest notes to make them sound like octaves, compared with the five lowest notes. (It was only necessary to alter the higher notes, since the lower the frequency, the less the effect of an error in the timing constant.)

Finally, playing about with the code can produce some interesting effects. For example, you could try RANDomizing USR 37047 and listening to the effects when interrupts are not disabled. Alternatively, try relocating the code to within the first 16K of RAM and listen to the 'orrible noises that come out. Perhaps you might like to try POKEing 37006,23 and watch what happens to the BORDER — if you dare! It's also possible to have several different T-state tables and POKE the relevant base address to 90BD (37053) and 90BE (37054) when required. YS

The Basic program used to access the Hex code shown below, allowing users to transform the Spectrum into a piano keyboard proper!

```
   1 REM ************************
   2 REM   C.ASHFORD -- 17.3.84
   3 REM ************************
   4 REM
  10 INK 1: BORDER 1: PAPER 1
  20 CLS
  30 PRINT AT 10,10; INK 7; FLASH 1;"LOA
DING CODE"
  40 LOAD "PIANO.XOB"CODE
  50 INK 7
  60 PRINT AT 8,10; FLASH 1;"stop tape"
  70 PRINT AT 10,2; FLASH 1;"press any b
utton to start"
  80 IF INKEY$="" THEN  GO TO 80
 120 CLS
 140 POKE 36869,9
 160 REM everything blue. This
 POKE makes the border            blue an
d the MIC o/p            off when in the
 ORGAN              routine
 180 REM ************************
 200 RANDOMIZE USR 37046
 210 REM call ORGAN
 220  REM
 230 REM
 300 INPUT "enter no of T-states: ";a
 400 LET high=INT (a/256)
 500 LET low=a-high*256
 600 PRINT "high byte=";high,"low byte="
;low
 610 REM this is a test number
 of T-states which is             POKEd i
n lines 70 + 80           to the address
in the            T-state table for the
          key Q (the test key).
 700 POKE 37093,low
 800 POKE 37094,high
 900 GO TO 200
```

The Hex code, which should be entered at 9000 Hex.

```
9000 FF FF FF FF 00 09 00 00
9008 00 00 00 00 00 00 00 00
9010 21 00 90 01 FE FB ED 78
9018 77 23 CB 08 ED 78 77 23
9020 06 BF ED 78 77 23 CB 08
9028 ED 78 77 C9 CD 10 90 06
9030 00 78 32 04 90 21 00 90
9038 16 04 1E 05 4E CB 19 04
9040 D4 4E 90 DC 53 90 1D 20
9048 F4 23 15 20 ED C9 78 32
9050 04 90 C9 ED 57 CB 3F C9
9058 7B E6 07 87 87 DD 21 95
9060 90 4F 06 00 DD 09 37 DD
9068 E9 CB 58 28 03 ED 5A 23
9070 7B CB 3F CB 3F CB 3F CB
9078 3F 3C 3D 20 FD 14 15 28
9080 09 3E 0E 3D 20 FD 3E 00
9088 18 F4 3A 05 90 EE 10 D3
9090 FE 32 05 90 C9 00 18 D1
9098 00 D0 18 CD 00 23 18 C9
90A0 00 26 00 18 C4 00 00 18
90A8 C0 00 D0 18 BC 23 00 18
90B0 B8 19 18 B5 00 00 F3 18
90B8 1A CD 2C 90 21 E3 90 3A
90C0 04 90 87 4F 06 00 09 5E
90C8 23 56 7A B3 28 E9 CD 58
90D0 90 18 E4 3E FE DB FE 1F
90D8 38 DF 3E EF DB FE 1F 38
90E0 DB FB C9 00 00 C5 22 DD
90E8 0E 2C 0C 00 00 AD 08 54
90F0 10 7A 0D F0 0A C6 09 A3
90F8 07 DC 00 22 02 BE 03 0A
9100 04 BC 05 7A 01 D3 02 00
9108 00 DD 04 A9 06 00 00 00
9110 00 00 00 00 00 00 00 00
```

PROJECT 4

An editor's life is not a happy one . . . at least not on the Speccy, and *Penny Page* invites you to improve your editorial skills.

So, it's thinking caps on and heads down for another chance to prove that, with a little bit of help from its friends, the Speccy is the most versatile micro this side of Krypton.

The Spectrum's editing facilities leave a lot to be desired — long lines in Basic can take an age to correct if you can only go backwards and forwards along the line. (If you press the 'up' or 'down' cursors while editing, only the 'current line marker' moves — leaving you in the same place!)

As you probably know, if you've been backed into the corner of your local computer club by a Spectrum-hater, many other micros have the facility to edit lines by flicking the cursor up, down, and all around. And so, without further ado, there's your task — recreate this editing feature on the Speccy.

All entries for Project 4 should be sent to our Projects Editor, *Penny Page* at *Your Spectrum*, 14 Rathbone Place, London W1P 1DE.

48K SPECTRUM

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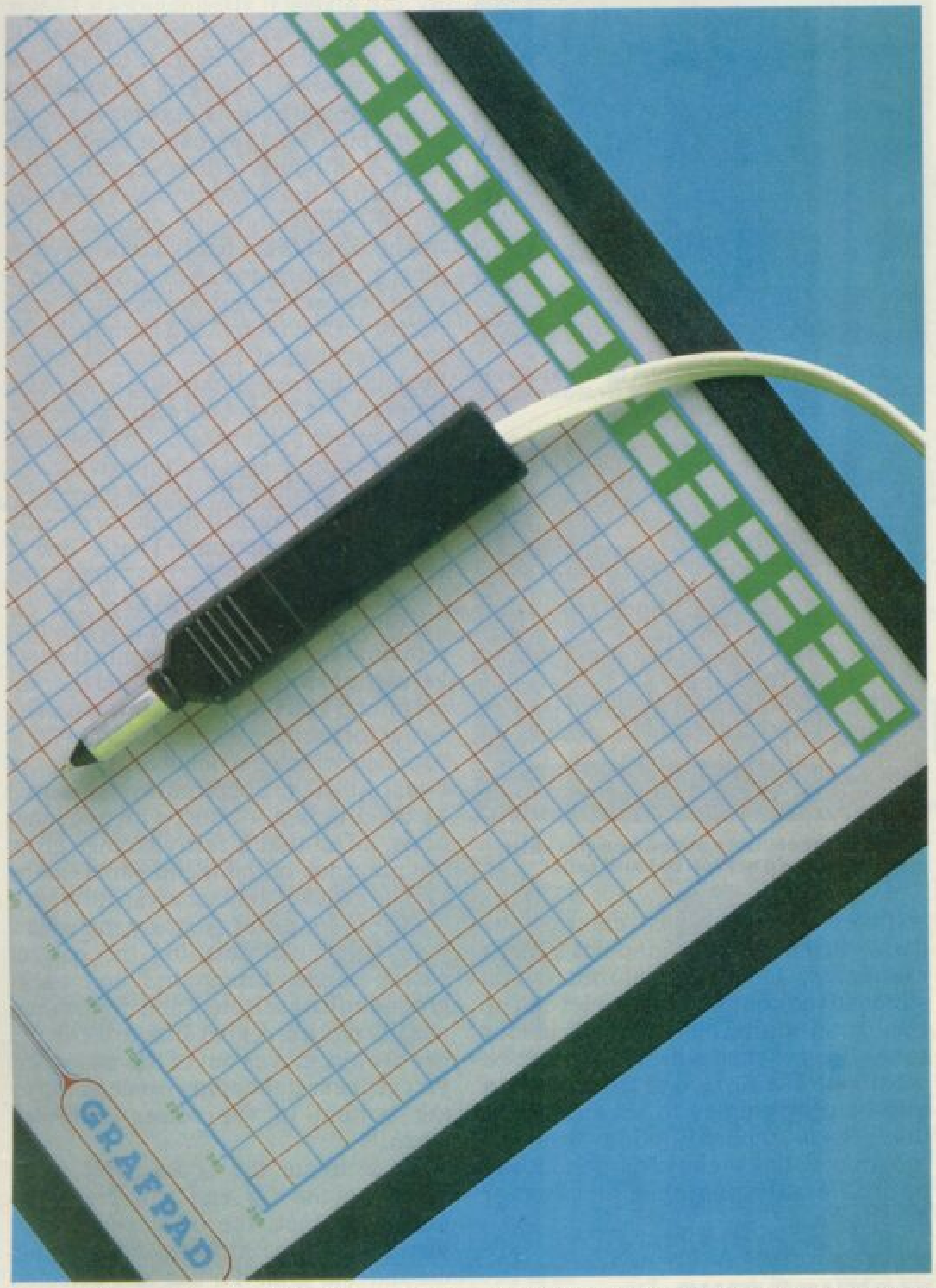
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YS HARDWARE REVIEW:

LUCK OF THE DRAW

Discussing the artistic potential of various micro add-ons, Henry Budgett concentrates his critical powers on British Micro's Grafpad.



One of the most powerful selling points of any of today's home computers must be the type of graphics facilities they have to offer. With just a few simple lines of Basic, great sweeping designs can be made to appear and disappear... colours change, new patterns emerge. Unfortunately, for the really creative user, all this requires expert programming knowledge. The concept can't be created on paper first and then loaded into the computer as a completed work of art. While there are a number of on-screen drawing programs which allow the creation and manipulation of an image, they cannot be used to copy a picture from a sheet of paper.

Designers, technical draughtsmen and architects, as well as interior decorators, landscape gardeners and fashion designers (to name but a few) can all benefit from the facilities that a computer graphics system can provide. Once the design is safely stored away on tape or disk, it can be quickly loaded back into the computer's memory. Now, additions and alterations can be tried without wasting valuable raw materials or creating a product that isn't quite what the customer expected. Yet all these potential users of computer systems are limited by the fact that the computer cannot be interfaced to a piece of paper!

TABLETS IN THEORY

So what's needed is an input device which can translate the lines and curves of the drawing or design into digital information that a computer can then recreate as a display. In the professional computer market graphics tablets have been around for almost as long as computers, but low-cost designs for the home user have only recently started to become available. High precision graphics tablets, also known as digitisers because they reduce analogue shapes to digital information, use a wide variety of techniques to produce the required information. Among the most accurate are the magnetic and capacitive systems; a capacitive system can offer accuracies of around 1/100th of an inch — sufficient for engineers and draughtsmen — while the magnetic method is potentially even better.

The cheapest and simplest digitisers are the various pantographs. Based on the same principle as the old-fashioned drawing aid, they use jointed arms and co-ordinate geometry to give a direct measure of the position of the stylus. Variable resistors (potentiometers) are mounted at the two joints that provide a varying voltage to the computer. This can be interfaced through a suitable analogue port; a joystick socket may be enough, given suitable software. The resolution of the pantograph is limited by the accuracy of both the variable resistors and the mechanical linkages; typically it's around five per cent. However, sophisticated pantographs based on optical measurement of the rotation of the joints can offer much better results, although they still fall short of the sort of accuracies that can be pulled from the best systems. While the pantograph is probably the simplest type of digitiser there is, it's often quite adequate for home computer use.

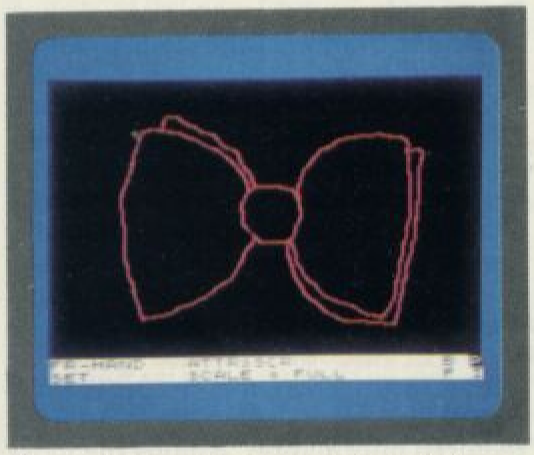
PUTTING THE PRESSURE ON

One stage more advanced than the pantograph (though still lacking the sophistication of a magnetic or acoustic digitiser) is the pressure sensitive digitiser. Often referred to as a 'bit pad' (although that's actually the trade name of a specific device) it can take one of two forms. The simpler of the two is based on a resistive sheet, often just

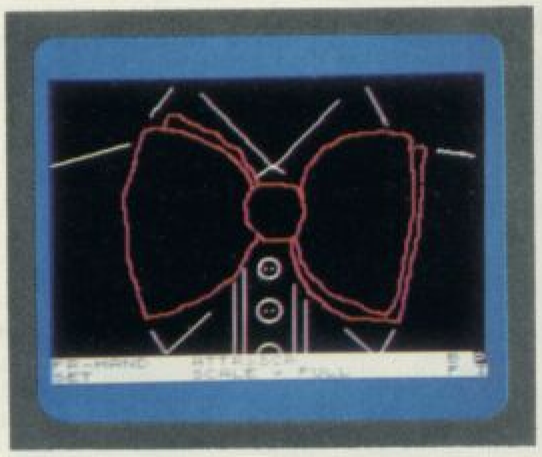
YS HARDWARE REVIEW:

LUCK OF THE DRAW

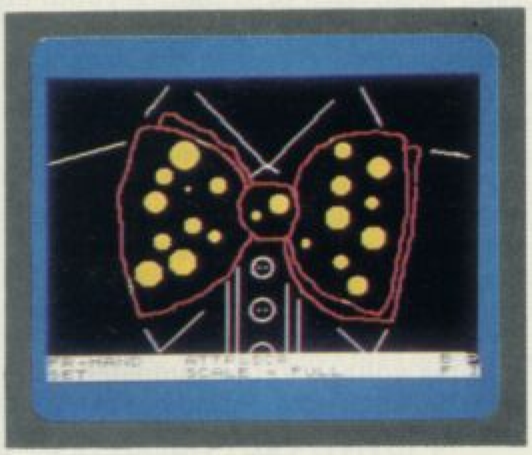
heavy paper with a graphite coating. If an AC voltage is passed across the sheet, a stylus will be able to detect the potential at any point. Using an electronic sampling method which is locked to the same frequency as the supply voltage, it's possible to derive a direct relationship between the voltage detected and the position of the stylus on the sheet.



For a night on the town, why not dress yourself up with a Grafpad? First, it's on with the red bow tie . . .



. . . and then the white shirt (a tricky item to draw, especially with the Grafpad's 'disappearing cursor' feature).



Be careful when adding colour — if you position the yellow dots too near the bow tie, they'll come out red instead.



One last touch, blue stripes on the shirt —now, where's my top hat and tails?

IAN McKINNELL

The second type of pressure sensitive digitiser uses two sheets of resistive material separated by a cellular membrane. The pressure of the stylus causes the two conductive surfaces to make contact, a principle that was used in the Sinclair Research ZX81 keyboard. A high frequency signal is fed into the two layers, each signal (normally) either opposite in phase or connected at right angles to the other. The signal detected by the stylus when it makes an electrical connection between the two sheets provides a measure of its position. Typical problems encountered with both these systems include changes in the surface resistance due to damage, or the pressure of a hand at another point on the surface.

The best types of digitiser available to the home user are based on either magnetic or capacitive effects. Both systems rely on a series of wire grids embedded in the baseboard of the tablet. In the magnetic system the grids are used to detect the position of the stylus which, in this case, is a coil radiating a pulsed high frequency signal. The signal detected by the grids is compared with a reference signal and provides a direct measure of the x,y position of the stylus. The capacitive system works the other way round in that the stylus is used to detect a series of coded pulses fed into a two-layer grid.

The data produced by a graphics tablet must be converted into information suitable for display on the screen and, to this end, most of the commercial products come with all the necessary software. However, just entering the data isn't the end of the graphics tablet's usefulness. Once the information is stored in the computer the tablet can be used as an editing tool, allowing colour to be added or changed and shapes to be modified. The surface of the tablet can also be programmed to act as a menu that selects standard options from the program, so that the keyboard need only be used for selecting major functions or entering text.

PICTURE THIS. . .

So much for theory — let's look now at a version for the Spectrum user. One such device called the Grafpad system from British Micro (previously only offered for the BBC Micro) has recently been adapted to work with the Spectrum and Commodore 64 systems. The unit comes extremely well-packed in polystyrene — not a bad thing considering it costs a fairly staggering £143.75 — and consists mainly of a 25mm by 355mm by 260mm black plastic box. Already that's a 'slight' discrepancy from the advertising blurb. . . they reckon it's only 55mm wide but what's a simple misprint between friends? Well, nothing really, except that they also reckon it comes with a light pen and. . . it doesn't. But then it does have a really nice stylus to make up for it!

Also included in the packing is a multi-way cable to link the tablet to the Spectrum's edge connector, a cassette containing the software, a keyboard overlay and a wad of A5-sized photocopied paper that claims to be a manual. The tablet is well-made and its surface is ruled with a grid corresponding to the Spectrum's graphics resolution of 176 by 256 pixels; it also includes a 32-box menu panel which can, in theory at least, be utilised by users to create their own software. The grid is protected from damage by a sheet of clear acrylic over which the stylus can be moved with ease — although it does scratch.

The first move is to connect the tablet to the Spectrum — an easy task you might think, that simply involves plugging a cable between the Spectrum's edge connector and an identical connector on the tablet? No such luck! On my Spectrum at least, the aluminium heatsink prevented the plug from being properly inserted. Out with the toolkit, some minor surgery and the cable now connects perfectly — although it's still too short to allow the tablet to go anywhere other than on the right, or directly behind the Spectrum. That's fine if you're right-handed, but then, not everyone is.

With the cable connected all that remains is to plug the stylus into the socket at the side of the tablet, load the program and start drawing. To make life easier for the user, a keyboard overlay is supplied which carries the various options. All of the Spectrum keys are used by the program — most with two functions, a fact that is fairly strange given the presence of the menu panel on the tablet. To keep the user aware of what's going on, the screen display includes a highlighted bar detailing the current screen mode, foreground and background colour selected, and the drawing and dot modes. A neat feature is that the bar always moves out of the way when you get near it, hopping from the top to the bottom of the screen and *vice versa*.

To activate the stylus, you press down on the tip and a microswitch makes contact; the on-screen cursor then follows the motions of the stylus around the grid. To use any selected function, press the Enter key and the function will operate as long as the stylus is depressed; releasing it cancels the function.

DRAWING ON EXPERIENCE

The single most difficult thing I found when using the Grafpad was to remem-

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YS HARDWARE REVIEW:

LUCK OF THE DRAW

ber whether I was drawing on the screen or mapping the attributes. The current screen mode is displayed in the centre of the information bar, so it should be simple to keep track of what's going on; however, dropping into Attribute mode and spraying colour across pixel boundaries can be very frustrating. The accuracy of the tablet is properly matched to the Spectrum — the grid inside the tablet's surface consisting of a wire mesh 176 by 256; the movement of the stylus on the screen corresponds exactly to its motion on the surface of the Grafpad. Don't expect too much at once because drawing freehand reuires practice and traced pictures are never really exact.

Fortunately the software makes allowances for this and it's generally quicker to knock up an approximate likeness and then use the editing features to tidy up. Of these the most useful is Magnify which blows up the selected area by up to eight times. Here the individual pixels are about the size of characters and you can Set and Reset them at will. The movement of the stylus is also scaled to the current magnification, so the picture doesn't leap about all over the place.

Among the other built-in features of note are the Line, Circle and Box drawing routines, all rubber-banded from any given starting point. Quite what the Vertical and Horizontal Line facilities are for is a mystery; they appear completely redundant. While almost all the routines work very fast indeed, the Circle is amazingly slow; any suggestions as to why would be gratefully received — there seems to be no obvious answer. To assist in matching your image to others the program provides two scaling grids, but neither really proved very effective. The highlight grid which produces alternate light and dark background character cells doesn't work with dark backgrounds and while the second grid is better, it reduces all the colours to magenta or white, making it almost useless for anything other than outlining.

Against these dubious features Grafpad does possess several very useful facilities. You can invert an image, flip up/down or left/right, and store up to two pictures, either elsewhere in memory or permanently on tape. Areas can be painted-in or you can edit the Attribute screen on a pixel-by-pixel basis (in Magnified mode if you really want to be accurate). If you want to protect areas of your picture from accidental damage, a window facility is provided and only the area inside can be edited while the window is active. About the only other interesting facility promised by the manual is that you can pick up UDGs, but it fails to suggest from where!

The manual actually fails to mention quite a lot and I only hope that the one I got is a prototype and not what the paying public will receive! Quite apart from the mis-spellings and shabby presentation it hardly tells you anything at all. It's almost as though it was translated from Esperanto by an artificial intelligence program suffering from dyslexia. (Author's note: all spelling mistakes in this review are the responsibility of the editor! [*No they're not, Ed*.]) All the commands are dealt with but seemingly in as few words as possible — it's more a quick reference guide than a piece of documentation.

GET THE PICTURE?

If you want to create works of art on your Spectrum's screen then you can certainly do it with the Grafpad. But then again you can also do it with the various screen-based editors like *Melbourne Draw* for substantially less than £143.75. The only thing the Grafpad has to offer that the screen-based packages don't is the facility to use the pen to trace an existing drawing on paper into the computer's memory; even this is limited by the accuracy of the tablet. Check it out yourself and draw your own conclusions. . . YS

BACK ISSUES BLITZ

Calling all Spectrum owners . . . if you've missed out at the newsagents, don't fret 'cause we've still got a few issues left over. Deep in the basement of Rathbone Place, our lovable layabout Distribution man, Trevor, stubbed his toe on some misplaced packages full of . . . would you believe it . . . back issues of *Your Spectrum*.

Well, we wouldn't want to get the poor guy in trouble for not selling them, so we're offering you the chance to help out. Check out the coupon at the bottom of the page and send it off quickly — there's not that many left, and we'd hate you not to complete your collection.

For all this and more — news and views, fun and philosophy, charts and chat, books and letters, rumours and reviews — look no further than the greatest Spectrum magazine around — *Your Spectrum*.

Please send me the following back issues of Your Spectrum (£1.10 each, includes handling).

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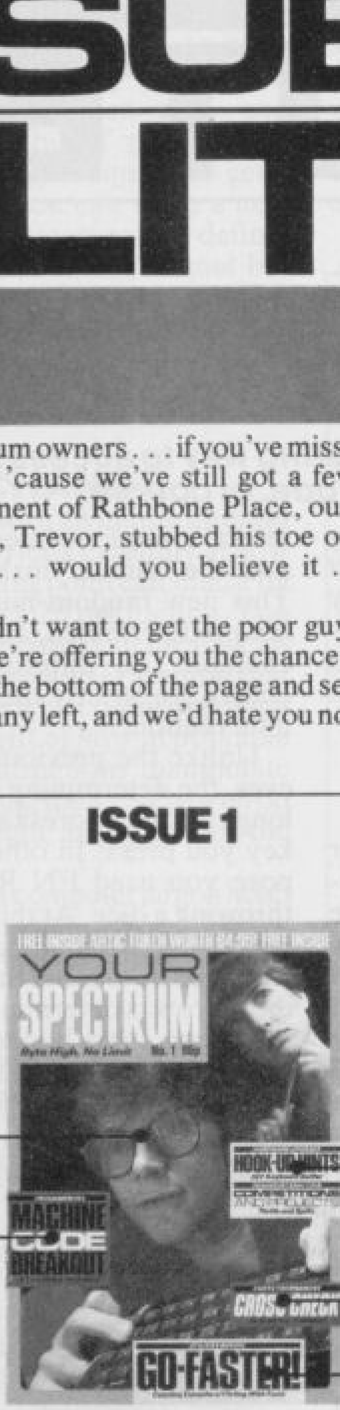
Date ____________________

Please fill in the order form (cheques/postal orders made out to *Your Spectrum*) and mail it immediately to: **Your Spectrum, Back Issues, 14 Rathbone Place, London W1P 1DE.**

ISSUE 1

Funny looking programmer — no, you don't have to look like this to enjoy the magazine!

Build a keyboard buffer for the Speccy under the expert guidance of **Stephen Adams**.



Grandmaster **Dr John Nunn** presides over five chess packages all challenging one another. Check it out!

Acknowledged expert on machine code, **Toni Baker**, came up with the impossible — a way to break out of machine code loops.

Have you considered that there could be anything faster than Basic. We did . . . and so should you.

ISSUE 2

Rather a cute cover — which suggests nothing of the great software reviews, machine code machinations, and hardware bits and bobs within. Ah, well.

The issue is resplendent with a giant poster-map giving the complete layout to Quicksilva's mighty **Ant Attack**, as well as an insight into Sandy White's programming ventures.



The QL is announced, and we send our spies into the hallowed halls of Psion to get the inside story. Full details on the mysterious micro inside.

If you've got software worth protecting, then get all the inside info from **Simon Goodwin**. You know it makes sense. . .

ISSUE 3

Add a little zip to your programming prowess — a tutorial on how to write good software. And just to prove it can be done, start organising your own compiler.

The QL gains momentum (well, nearly) and **Andrew Pennell** takes a good look at SuperBasic and compares it to the ZX Basic we all know and love.



Durell Software release **Scuba Dive** for the Speccy, but wouldn't you just love to see the whole thing? Come on in, the water's lovely.

A Spectrum — but what issue is it? Learn how to look for the tell-tale signs as **Stephen Adams** inspects the guts of the machine.

ISSUE 4

Fed up with the quality of the ZX Printer? There's a lot going for upgrading, as you can see by the subtle colour simulations you can achieve — and all it needs is a little bit of code. S'amazing really!

For the best screen shots of all your favourite games, look no further than **YS**'s review pages. (So what if our ace photographer told me to write that — it's true!)



Along with a detailed review of **Jet Set Willy**, **Andrew Pennell** decides to see just how the game ticks. Follow the trials and tribulations of a closet hacker as he makes his way through the fully illustrated plan of Matthew Smith's wonderworld.

At long last **Quentin Lowe** gets a close look at a QL. Find out all the gory details of the hardware, software and. . . the dreaded 'kludge'.

A CHANCE ENCOUNTER

***As luck would have it,* Toni Baker has come up with an interesting way to access true random numbers — with a little help from machine code, of course.**

As many of you will know, random numbers on the Spectrum are not truly random — they may *appear* to be random, but they are in fact totally predetermined. For instance, RANDOMIZE 42 followed by PRINT RND,RND will always give the same numbers: 0.049194336 and 0.69065857; I haven't cheated by using the RANDOMIZE statement, I've just used it to make the point easier to demonstrate — RND does *not* rely on chance.

RANDOM THOUGHTS

Now when you play any sort of game which involves the throwing of dice or the tossing of coins, then one would usually agree that the outcome *is* truly random. (At this point, the philosophers amongst us may like to have a quick debate on the various merits of free will versus determinism.) Isaac Newton would tell us that if we knew all the variables involved (velocity of dice, density of air, etc) then we could work out in advance which number would get thrown; on the other hand, Schrodinger's Cat tells us differently. Maybe the world is flat after all.

So now you should be able to see the subtle difference between the formula INT (6*RND)+1 and throwing a dice. However many suitable tests for randomness you may care to think up, one overriding fact remains — that, whereas dice-rolling involves the mysterious hand of fate, the RND formula is completely predetermined. The outcome of a dice game is fixed before you even press RUN.

You can add a little bit of chance into the game by putting a RANDOMIZE statement into your program somewhere (without a number after RANDOMIZE). This will confuse the issue a bit, but it still won't stop the remainder of the game being just as predetermined as ever. What you *could* do instead is to precede every single use of RND by either an INPUT statement or a PAUSE 0 statement, followed by RANDOMIZE. For instance:

```
PAUSE 0 : RANDOMIZE : LET D+ INT
(6*RND)+1
```

This will prevent the game from being predetermined by relying on the fact that a human player will not necessarily wait the same number of TV frames before pressing a key; it'll load the random number seed with a different value each time and hence give you a different random number each time.

A TRUE DEFINITION

But I'd like introduce you to another approach. I'm going to define a user-defined function called FN R(X) (the number inside the bracket is important). Here's what happens when it's reached in the middle of a Basic statement. Firstly, control will PAUSE until a key is pressed, and then the computer will select a random integer between one and the number inside the brackets. This new random number function is *not* predetermined, and as in the above example, its differing possible outcomes are strictly the result of human intervention.

Unlike the previous example, however, the determining factor is not how long you take to press a key — it's *which* key you press! In other words — suppose you used FN R(6) to represent throwing a dice. At this point the action would PAUSE. The human player would be aware that the outcome of this dice throw is determined only by which of the keys she or he decides to press, but does *not* know, and can *never* know,

CODE		ASSEMBLER	COMMENTS
CD8E02	CHANCE	CALL KEY_SCAN	DE:= immediate keyboard scan.
1C		INC E	
20FA		JR NZ,CHANCE	Waits until your finger is released from the last key pressed.
CD8E02	NEW_KEY	CALL KEY_SCAN	DE:= immediate keyboard scan.
1C		INC E	
28FA		JR Z,NEW_KEY	Waits until a new key is pressed.
43		LD B,E	B:= code corresponding to the key pressed.
C5		PUSH BC	
ED4B765C		LD BC,(SEED)	BC:= random number seed.
CD2B2D		CALL STACK_BC	Pushes this seed on to the calculator stack.
C1		POP BC	B:= key code.
EF		RST 28	Uses the floating point calculator.
A1		STACK 1	S,1
0F		ADD	S+1
343716	CH_LOOP	STK DATA 75	S+1,75
04		MULT	75*(S+1)
348041			
000080		STK DATA 65537	75*(S+1),65537
32		MOD	75*(S+1) MOD 65537,75*CS+1) DIV 65537
02		DELETE	75*(S+1) MOD 65537
35F3		DJNZ CH_LOOP	SEED+1
A1		STACK 1	SEED+1,1
03		SUBTRACT	SEED
38		END CALC	And back to machine code . . .
CDA22D		CALL FP_TO_BC	BC:= new random number seed.
ED43765C		LD (SEED),BC	Stores this new seed.
C9		RET	Returns to Basic. Note that this final value will be divided by 65536 to give a final random number.

which key gives which result. As in real life, the human being determines her/his own fate, and synchronicity alone choose the winners and losers.

The algorithm I've used to define FN R is an almost direct rip-off of the RND feature in the ROM, except that I've added a bit to allow for human intervention. It's mostly a machine code routine, but the machine code only works out a random number between zero and 65535, and so a bit of multiplying, dividing and INTing is required to get it into range. See if you can write a new Basic DEF FN statement to define, say, FN S() as a random decimal between zero and one — you can use exactly the same USR call (that is, my machine code) as I've used for FN R(X) but you'll need to change the rest of the statement.

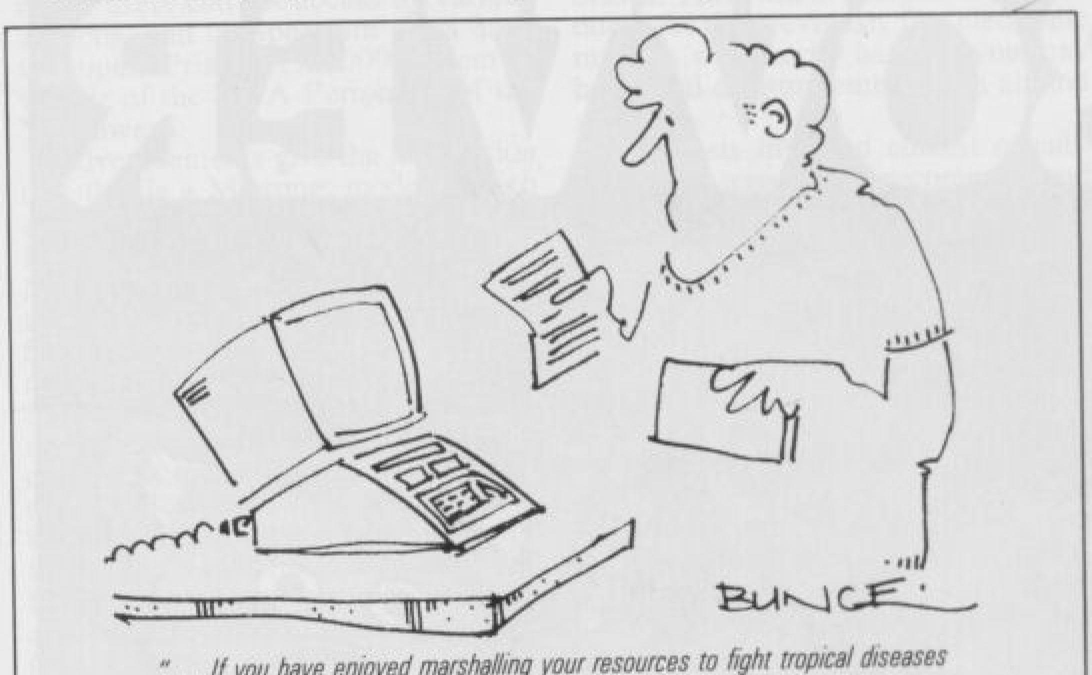
CHINESE CHANCE

For those of you with an inquiring mind (all of you, I hope) look carefully at how I've used the floating point calculator by bringing in the RST 28 instruction. You don't need to understand all the the calculator instruction codes (I'll admit that 348041000080 is a bit confusing) but if you can get the drift of how in principle the calculator instructions manipulate the calculator stack, then you're well on the way to the light at the end of the tunnel.

I've used a bit of computer jargon here, which I'd better explain. We all know that 15 divided by seven is two remainder one. In fractions, it's 2 1/7, and in decimals it's 2.142857 . . . but let's just stick to integers — it's easier. In general, A divided by B is Q remainder R. In computerese we can write 'A DIV B' to mean Q, and 'A MOD B' to mean R. Thus, in the above example 15 DIV 7 equals two, and 15 MOD 7 equals one. Mathematically we can say that A DIV B equals INT (A/B) — see if you can work out what the mathematical formula for A MOD B is. Anyway, that explains all the unknowns — let's move on now to a bit of program.

This is a Basic program for throwing Chinese coins. The question marks in the last line refer to the address of the machine code routine labelled CHANCE, which is listed separately. See you up there. YS

```
10 FOR I=1 TO 6
20 LET C=FN R(2)+FN R(2)+FN R(2)
30 PRINT AT 6-I,0; "---";
40 IF C>4 THEN PRINT "space";
50 IF C<5 THEN PRINT "-";
60 PRINT "---"
70 NEXT I
80 DEF FN R(X)=INT (X*USR ?????/
   65536)+1
```



". . . If you have enjoyed marshalling your resources to fight tropical diseases — try our new game — Herpes."


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picnic!
artic
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ZX PHONE HOME!

As computerised bulletin boards spring up all over the country, you're going to miss out on all the action unless you get hooked up to a phone fast. Our man on the line,* SQ Factor, *checks out the scene.

As micro ownership becomes more widespread and the initial fascination with 'zap' games wears off within the growing userbase, more of us are getting involved with distant computers and databases via the telephone lines.

This used to be the only way one could have a 'home' computer at all. The computer itself resided in a remote air-conditioned basement, and the user sat before an enormous electro-mechanical teletype machine. This would display the dialogue by printing on a continuous paper roll, with the consequence that operators of such a link gained a nickname from the intermittent 'hack hack hack' that distinguished their input from the regular chatter of the mainframe's reply.

Not a lot of people know about that in these days of glass-faced terminals and thermal printers. And the people who do tap away in the wee small hours nowadays (to avoid the peak time charges) are much more likely to be communicating with their bank or checking the market figures than to be polishing their latest Fortran monsterpiece.

In fact, modems are becoming consumer products at a rate fast approaching that which has put micros into the major retail chains. And about asterisk-ing time, too, says British Telecom.

PRESTEL ET AL

BT is uncharacteristically at the forefront of the new wave, with its Prestel database, the biggest and best anywhere. Prestel has over 300,000 pages of information, plus electronic mail and a link to the Telex system. So far this technical achievement has been typically British — that is to say, it's a commercial failure admired all over the world.

However, the fortunes of Prestel and its myriad Information Providers (Prestel doesn't actually fill many of those pages, but rents them to the IPs) are on the wax. Subscribers to the system now number upwards of 40,000, and new IPs providing home banking, shopping and other such consumer oriented services are taking the subscriberbase away from the travel agent specialist services and into the home of everyman.

Many of these new services are launched with dedicated Prestel terminals which will do nothing else, but micro users can get access by various add-ons, and us Spectrum users have the superb Prism VTX5000 modem — winner of the BMA Peripheral of the Year award.

Advertisements give the impression that this is a Micronet modem which can also get Prestel, but Micronet is a Prestel IP and not a separate system. Nor is it the only microcomputer interest section on Prestel. There's also Viewfax — a similar sort of electronic magazine with the same sort of features as Micronet, but not as extensive. The reason that Micronet is bigger is that it charges a subscription, and Viewfax doesn't. Both have daily news from the micro world, downloadable software, letters from readers, informative and humourous columnists (MicroMouse and MicroGnome), and sub-IPs (usually advertisers).

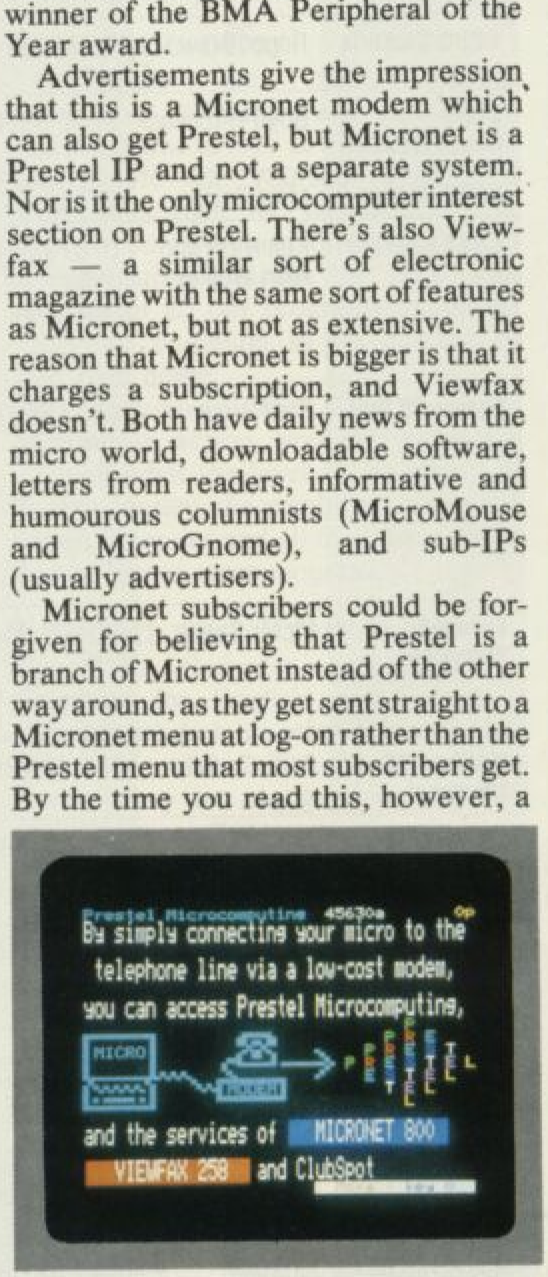
Micronet subscribers could be forgiven for believing that Prestel is a branch of Micronet instead of the other way around, as they get sent straight to a Micronet menu at log-on rather than the Prestel menu that most subscribers get. By the time you read this, however, a computer interest menu will have taken its place, giving a menu-selected route to Viewfax as well.

Unfortunately, this change goes beyond menus, and the Viewfax section will no longer be free to all Prestel subscribers. Viewfax is to get a share of the Micronet subscription, which will become the 'Prestel Microcomputing' subscription. This will not disturb Micronet subscribers much (as the cost will be the same) but non-netters will be entitled to feel that part of the Prestel service for which they are already paying Prestel subscriptions is being withdrawn. And when charges are introduced for the previously free electronic mail, as will shortly happen, you may hear loud disgruntlement from all and sundry.

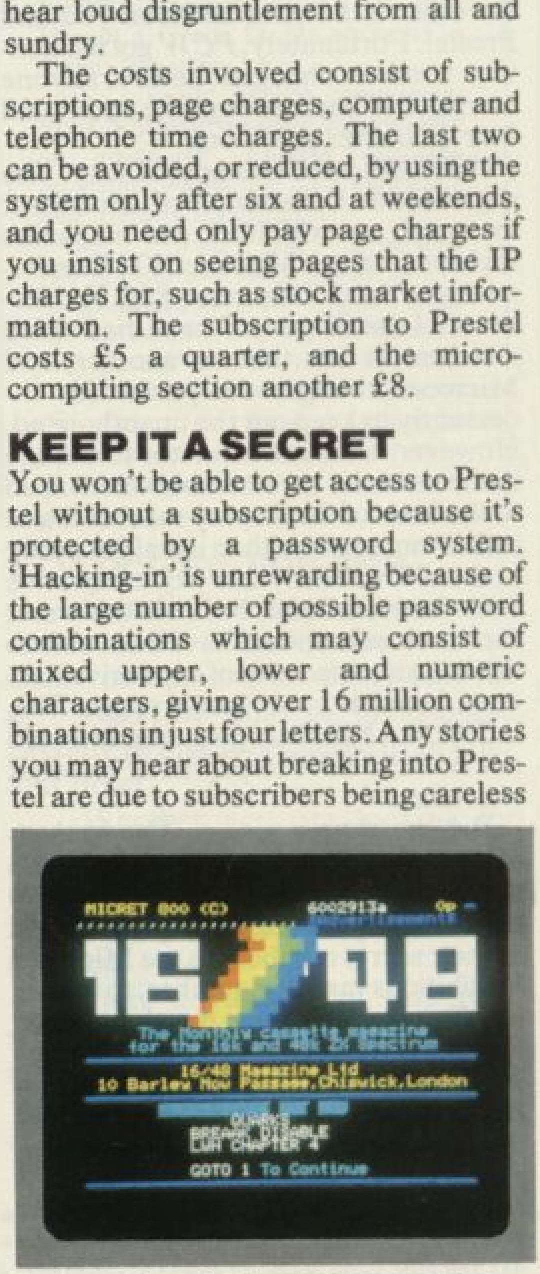
The costs involved consist of subscriptions, page charges, computer and telephone time charges. The last two can be avoided, or reduced, by using the system only after six and at weekends, and you need only pay page charges if you insist on seeing pages that the IP charges for, such as stock market information. The subscription to Prestel costs £5 a quarter, and the microcomputing section another £8.

KEEP IT A SECRET

You won't be able to get access to Prestel without a subscription because it's protected by a password system. 'Hacking-in' is unrewarding because of the large number of possible password combinations which may consist of mixed upper, lower and numeric characters, giving over 16 million combinations in just four letters. Any stories you may hear about breaking into Prestel are due to subscribers being careless



Well, it's a bit more tricky than this ad implies — but there's certainly a whole world of information out there.



And speaking of ads, you can even find out more about competing titles to Your Spectrum. (What's this doing here? Ed.)



If it's news you're after, Micronet 800 will provide you with all the 'dirt' on the Sinclair Research!



Keying '01' will provide you with a fast menu of items you can access on Micronet.

ZX PHONE HOME!

with their numbers, rather than clever work by some whizz-kid. Some of the more prominent names among the 'careless' might surprise you. *PCW* magazine published its identity number on the contents page of a recent issue instead of its 'systel' number. The systel number is the public number used as an address to send mailbox messages to — the other is a secret between you and Prestel. Fortunately, *PCW* got its identity number changed before anyone managed to hack through the additional four-character password.

Micronet itself was not so lucky. The organisation has a couple of identities it loans out to exhibitors and magazine reviewers called 'Micronet 800 Demonstrations' and 'Micronet 800 Exhibitions'. Lots of people have had these numbers at one time or another, and Micronet changes the passwords incessantly to keep out the unauthorised. However, a recent exhibitor found the numbers easier to remember when taped to the front of the display machine, and rather more people than usual got a look at them! Ordinarily this would not have been a catastrophe, because the worst the interlopers should have been able to do was download a lot of expensive software from Micronet's own pages. This is theft, but Micronet presumably would not actually have to pay itself for what was taken.

But the story goes on. The hackers apparently sent mailbox messages (purporting to be from Micronet) to legitimate 'netters asking them to send in their secret numbers to the Micronet Exhibitions mailbox number, to help in an effort to catch some naughty person sending lewd mailboxes. Some 'netters fell for the con, and shortly found themselves locked out of their own account; the hackers had logged on with their identity and changed the password. The moral of the story. . . don't tell *anyone* your secrets!

ON THE DOUBLE

Prestel modems use a split baud rate of 1200/75, which has now become a European standard for such systems. German and Dutch Prestel-type databases can be called up on a Prestel modem, as can a growing host of domestic, private and commercial systems, provided you know the numbers. For once, perhaps, a 'standard' may be stuck to, and a Prestel modem looks like an investment for the future rather than a toy of the moment.

The idea of the twin speeds is that Prestel needs to send a lot of data while you need usually send only an occasional menu selection. However, the characters *you* transmit will be used to buy goods, book tickets — usually just spending money in some way — so they are sent at a slower speed; presumably less susceptible to corruption by line noise. It makes sense, but there are other standards.

FROM LITTLE ACORNS. .

The original standard for data links (ignoring Telex's 50 baud, which is still the international Telex standard) was limited less by the telephone system than by the speed of the mechanics of the teleprinter, and so remained at 110 baud long after the VDU took over. Some systems still use 110 baud, but at just 10 characters per second it's too slow, and has been largely superseded by 300 baud.

The people who use 300 baud are the pre-consumer boom professionals and enthusiasts. A lot of the private and corporation databases are on 300 baud, especially in the USA, where breaking into private (or even government) data-

THE BULLETIN BOARD BOX

TITLE	CONTACT	PHONE NUMBER	RING BACK FAC.*	FURTHER DETAILS
CBBC Cumbria	Roger Drew	069 92314	Yes	300 baud V21, 300 baud Bell and 1200/75 V23.
CBBS South-West	Boyd Hitchcock	0626 890014		24-hour operation.
CBBS Surrey	Mike Parker	04862 25174		24-hour operation.
CBBS Chiltern	Ken Hirst and Alan Walker	07073 28723		Operation is provided from 18.30 to 22.30. (Note that the phone number changes on Mondays and Wednesdays to 07073 39241.)
Forum-80 Hull	Fred Brown	0482 859169		Operation times are: Tuesdays and Thursdays — 19.00 to 22.00; Saturdays and Sundays — 13.00 to 22.00; and daily (for the USA) — 00.00 to 08.00 Bell 103.
Forum-80 Wembley	Victor Saleh	01-902 2546		Operation is provided in the evenings and weekends. Just ring up and ask for Forum-80.
Mailbox-80 Liverpool	Peter Tootill	051-428 8924		24-hour operation.
Mailbox-80 West Midlands	Jim Roden	0384 635336	Yes	Operation is provided every day from 17.30 to 08.30, plus Sundays all day.
TBBS London	John Nolan	01-348 9400		Operation is provided every day from 09.00 to 01.00 CCITT and 01.00 to 09.00 BELL 103.
TBBS Southampton	Chris Cain	0703 437200		Operation is provided on weekdays from 17.00 to 08.00, and all weekends.
TBBS Blandford Board	Leo Knaggs	0258 54494		24-hour operation.
Southern BB	Jonathan Sanders	0243 511077	Yes	Operation is provided from 20.00 to 02.00.
MG-NET CBBS London	Peter Goldman	01-399 2136		Operation is provided on Sundays only, from 17.00 to 22.00
BBS North Birmingham	Paul Smith	0827 288810	Yes	24-hour operation.
CABB Computer Answers	Tony Dennis	01-631 3076		24-hour operation. There is a 300/300 service, but the 75/1200 service is still not working.
British Apple System Users Group		0742 667983		24-hour operation

*The 'ring back' facility consists of you dialling the relevant number, letting it ring once, replacing the receiver and then re-dialling.

These bulletin boards are all free British systems and can be accessed by anyone with the necessary equipment.

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S

bases has become a popular pastime. You don't have to get involved in such activities to have fun with a modem, however, as there are many public access hobbyist databases devoted to interests varying from computing (of course) to wife-swapping (it gets so boring in California). You can even get Prestel on 300 baud if you insist, but only on a London phone number.

For a computer nut, the amateur bulletin boards are more interesting than Prestel as a whole. Where else could you read a letter from Douglas Adams about how he is using a DEC Rainbow and *Brainstorm* to design the Hitch-hikers Guide video game, if not on Peter Tootill's board in Liverpool? Reading other people's mail (providing they don't flag it 'private') is allowable in the club-like recesses of a board, but could never be sanctioned by Prestel.

While the individual boards are a lot smaller than Prestel, there are a lot more of them — especially if you are prepared to phone very long distance. Fred Brown's board in Hull has a list of foreign boards so long that downloading it will in itself cost as much as a call to the States. The individual nature of these enthusiast systems, and the free access to all comers, makes them adventurous when compared to the more regulated Prestel.

HARDWARE SHOPPING LIST

First the bad news. The RS232 port on Interface 1 is not quite the real article. It won't work with a proper full duplex modem, as used by almost all remote systems.

The Interface 1 manual is very vague on the RS232 link, possibly because it tries to avoid making this admission. Dr. Ian Logan's *The Spectrum Microdrive Book* has much more information, including some on using the RS232 to link other computers to the Spectrum, but he does not mention modems. This is very significant, for Logan helped to write the Shadow ROM.

The problem is simply that turning a byte of data into a stream of bits or, conversely, assembling a stream of bits into a byte, requires the personal attention of the Spectrum's CPU, and it can't do both at once. Most serial ports depend on a dedicated chip to serialise the output and parallelise the input, and the CPU need only check on the port once in a while to see if a byte has come in or if one can be sent. Interface 1 saves the cost of this chip by doing the job with software. Don't complain, it's your money that's being saved, and you can use the RS232 link for just about anything but a full duplex modem. I've used it to download files from a CP/M computer and to store Basic listings on the disks of the same machine for printing later.

When the Spectrum sends a byte, it has to hang around sending and timing each bit. And when it goes to look at the input, it arrives in the middle of a byte, like as not. This is much worse than missing a byte entirely, as it garbages the following bytes as well by putting the whole stream of bits out of step.

If you're hooked to another computer, the handshake lines can be used to stop the other computer sending until the Spectrum is ready — but this won't work with modems, which have only one line to send a signal down. They use separate pairs of tones for high and low on originate and answer, and these four tones are about the limit that can be reliably accommodated on a phone line.

So if you want to get onto 300 baud with a Spectrum, you'll need not only a modem, but a proper RS232 port. There aren't that many available, but Maplin has one that looks particularly attractive; it's not only inexpensive, but has its driving software in an on-board EPROM. Unfortunately, the Maplin representative who promised to send me a unit for review was subsequently nobbled by terrorists from the international VIC users underground — otherwise, I would certainly have received it by now. Maplin also does a very cheap 300 baud modem, but both items are in kit form. Maplin also operates its own bulletin board.

The add-on RS232 port that I have used is produced by U-Microcomputers, the Apple specialists. This is a much more costly unit, and requires a software driver to be loaded from tape. . . on the other hand, it does come ready assembled. Using it requires some software ability on the part of the operator, and you'll have to use the dreaded soldering iron to deal with the baud rate selection, at least. However, it does give you lots of facilities, with two channels, split speeds, and lots of control over things you probably don't even want to know about. This is the one you'll need if you go for a multimode modem.

IN THE MOOD FOR MODEMS

Once you have your RS232 port, the range of modems available borders on the vast, and will certainly attain true vastness soon. Super single chip versions are appearing on the market now which will cope with all the different baud rates and tone standards, all in one box; some of them are even BT approved! The best known and most talked about — probably because it was the first fairly cheap multimode — is the Minor Miracles WS2000, but a flock of similar items are chasing hard on its heels.

The WS2000 will cope with 300, 600 and 1200 baud, both European and USA (same speed, different tones) standards. It will also work with the 1200/75 for Prestel; and it will also do it backwards, 75/1200, to communicate with a computer using a Prestel modem (110 baud usually uses the same tones as 300, so that, too, should work). Multimodes all cost over £100, but if you are happy to be restricted to 300 baud, then there are lots of modems at £50 or less available on the surplus market — or in kit form from Maplins. Points to look for are:

Originate/answer – The box making the call should use 'originate' tones, the other uses 'answer'. If you want to have others phone you as well, then one of you will need both, otherwise 'originate-only' will do.

US/Europe – Yanks use different tones and drive on the wrong side of the road. Don't complain to me. If you want onto US boards then you pay more. US stan-

COMMERCIAL BULLETIN BOARDS

TITLE	CONTACT	FURTHER DETAILS
Prestel	FREEFONE 2296	They will give you the information to apply for an account and a jack socket. For the 1200/75 service, local phone numbers are issued, and you'll require special hardware and software. You won't need anything special for the 300 buad service, but make enquiries on the same number. For more details of VIEWFAX 258, consult page 800890 within Prestel.
Telecom Gold	Julie Ireland, 42 Weston Street, London SE1 3QD.	
Comet	John Douglas, BL Systems Limited, Grosvenor House, Prospect Hill, Redditch, Worcs B97 4DQ. Tel: 0527 64274	
Micronet 800	Durrant House, 8 Herbal Hill, London EC1R 5JB. Tel: 01-837 3699	

ZX PHONE HOME!

dards are often called Bell, ours are called CCITT after the famous Belgian inventor.

Autodial – Not just laziness, sometimes you will have to dial repeatedly to get on to a popular board. This is especially useful for call-back boards, where you ring once, hang up and ring again. This is often done when the board shares the domestic phone, so that the household knows when the phone call is for the computer. Autodial can cost a lot extra, but a cheap, non-approved push-button phone with last number re-dial is almost as good and easier to use.

Auto-answer – Lets the computer answer the phone. It's only needed if you want to set up your own board, in which case you also need at least half a Megabyte of disk drives.

Acoustic/direct coupled – You aren't allowed to couple directly to Telecom lines unless BT approves. However, absolutely no one pays any attention to this. Get a few phone sockets put in so you can move the phone from room to room and make sure your modem has a suitable plug. (Buy some BT shares as insurance.) Ideally, the modem plugs into the wall and the phone into the modem. If you get a Prestel subscription, they put in a socket more or less automatically, and charge maybe £15 to £25.

If you want Prestel on a Spectrum then the Prism VTX5000 (£100) is the only way to go. This is because the Prestel page is 40 characters wide, while the Spectrum screen is only 32. Prism's modem contains a splendid program in ROM which downloads itself on power-up and deals with this and all other quirks of the system. It's all menu driven, easy to use and packed with useful features. A multimode would require an equivalent program, and I haven't heard of any for the Spectrum. The Beeb can use a multimode on Prestel more easily because it already has a Prestel-style screen mode. The 300 baud Prestel service in London is designed for non-graphic terminals so it's not very pretty, and it still expects a 40 column screen.

THE BULLETIN BLUES

It would therefore seem that two separate modems are necessary if you want to see it all, but there is another aspect to the advent of the multimodes. Some of the bulletin board operators are beginning to use multimode modems at their end. Originally this was to tempt USA callers by providing Bell tones at certain times of day, but some boards have now been set up to detect the standard a caller is using from the transmitted tones, and adjust themselves to suit the caller — even if you're using Prestel standard. This approach is not without its odd problem either, as Prestel is a paged system and the boards are based on scrolling; but it is just usable if you can cope with a messy screen, and eventually someone will come up with a modification of the Prism modem software to eliminate the mess.

It remains to be seen whether the bulk of the systems operators will want to go to the trouble of attracting hordes of Micrognats to their already well-populated and unpaid bulletin board services. If they do, please try to remember that they are on our side, and not a target. I mean, fun's fun, but disrupting an amateur board is not particularly clever or impressive. They are meant to be accessible, and if making them more widely accessible brings in too many CB type wallys, no one will bother.

Incidentally, if that wife-swapping notion is still preying on your mind, then try the Sympatico contact pages on Prestel, sub-heading Heartsearch, or indeed *Time Out*'s electronic small ads.

The tables included in this article come from good ol' Roger Drew's CBBS board in Cumbria. Roger is one of the pioneers who is trying to get his board to sync with all-comers — not an easy task. I have cut out all the menus and communications rigamarole in order to give you a false impression of how easy it all is. YS

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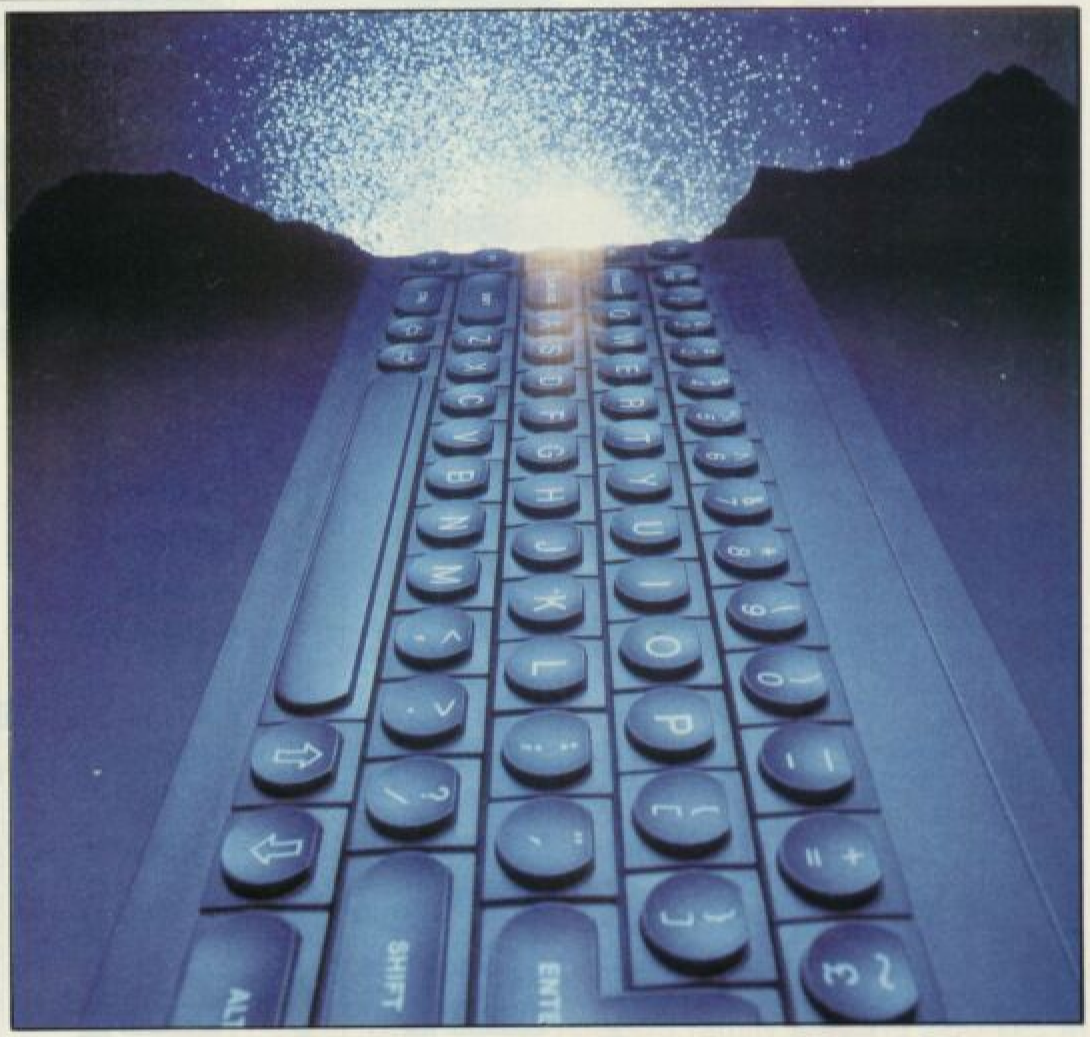
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QL User appears each month within the pages of _Your Spectrum_. Look out too for the 'Complete Dossier' edition — in the shops this July.



A PROCESS OF PHILOSOPHY

The difference between the Z80 and 68008 processors is one of philosophy, contends* Simon Goodwin, *and not just a matter of a few extra bits

Ever since Sir Clive announced the launch of the QL there's been great fuss over the choice of processor for the new machine. Sinclair Research advertisements describe the 68008 as a '32-bit processor', while journalists rush to their fact-sheets and deduce that, with it's eight-bit data bus, the processor is in fact little more than an inflated Z80.

FIRST THINGS FIRST

The first microprocessors were designed in a rather *ad hoc* manner, rather like the first computer programs. A few people thought for a while and came up with the bare bones of design — the internal timing of instructions, the interface between processor and memory, and some idea of the 'logical operations' possible — rotating values, adding, setting bits, and so on. Parts of the design were built up and tested in hand-made units, each comprising of a few hundred 'building-block' chips.

Once the bare bones were established, the race was on to flesh them out as much as possible. In essence, the designers considered each part and tried to work out all of the useful things that could be done with it. In the process they added a few registers, took away an operation, and so on until the chip — the slice of silicon used as a base for the processor — was chock-a-block with transistors. Then they tested everything and produced a book listing the 'instruction set' of the device; if anything didn't work, they just didn't mention it at all!

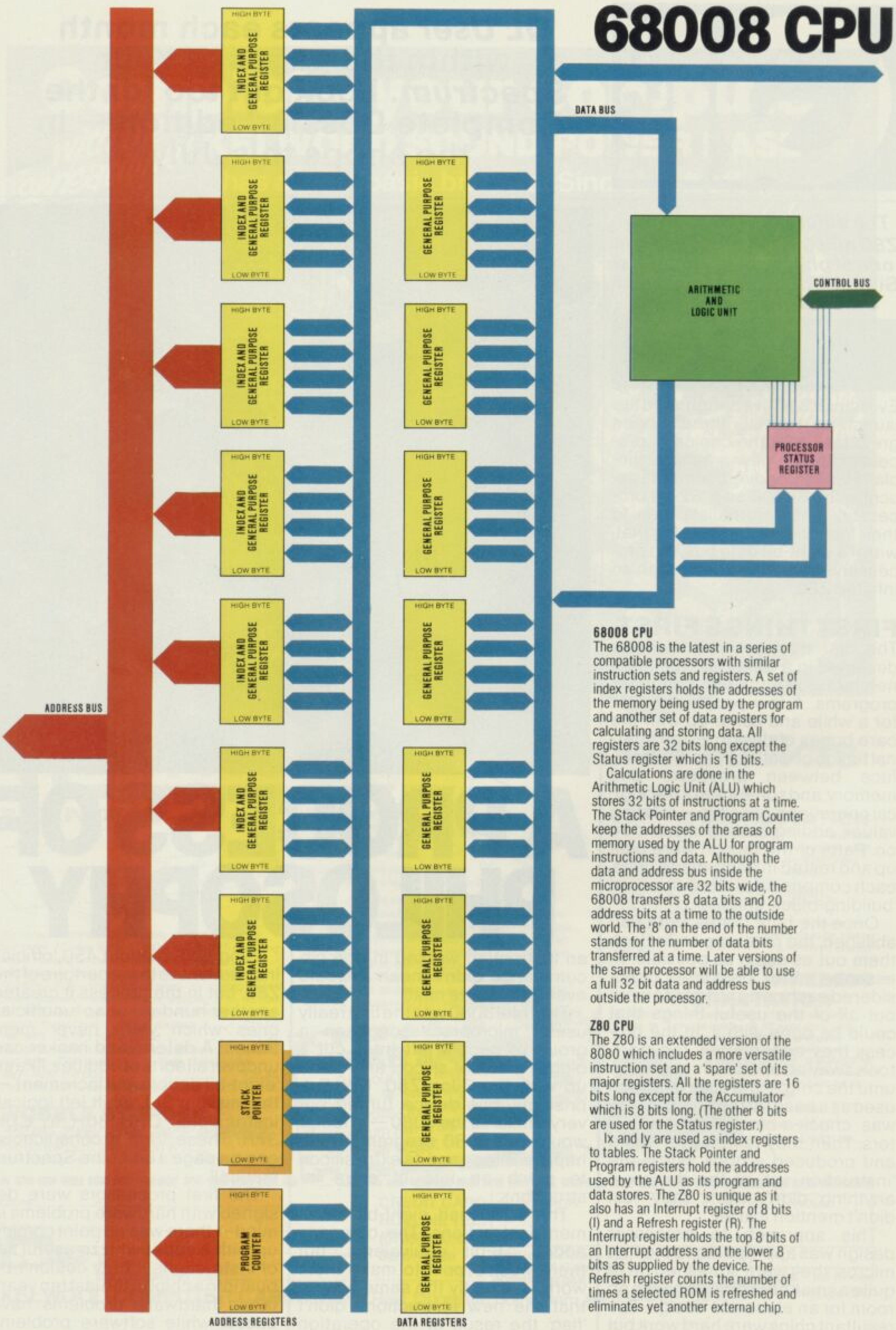
This approach to processor design was appropriate to the first micros; they were squashed on to quite a small area of silicon, with no room for an elaborate design. The resultant chips were hard work but great fun to program. Just because an instruction worked in one circumstance didn't mean it would even exist in the next!

The Intel 8080 was the first really useful microprocessor; then a group of people left Intel, cut a bigger piece of silicon and came up with the Zilog Z80. Not surprisingly, this device turned out very similar to the 8080 — in fact, it would run 8080 programs quite happily. Zilog used its extra silicon to stitch on lots of extra instructions.

The 8080 had eight-bit increment instructions. The company added 16-bit equivalents, but there wasn't room to make them work, ie. exactly the same way so that the new instructions didn't 'flag' the result of the operation (zero, overflow or whatever).

Zilog added about 450 'official' instructions to the repertoire of the Z80, but in the process it created another hundred or so 'unofficial' ones which were never mentioned! A determined hacker can uncover all sorts of oddities, like an 'eight-bit double and increment' — the missing SLL (shift left logical) instructions: CBH 30H to CBH 37H. These form a conspicuous gap on page 184 of the Spectrum manual!

The first processors were designed with hardware problems in mind — there was no point coming up with a super-whizzo useful set of instructions if they couldn't be built into a chip! In the last ten years these hardware problems have eased, while software problems have multiplied.



68008 CPU
The 68008 is the latest in a series of compatible processors with similar instruction sets and registers. A set of index registers holds the addresses of the memory being used by the program and another set of data registers for calculating and storing data. All registers are 32 bits long except the Status register which is 16 bits.

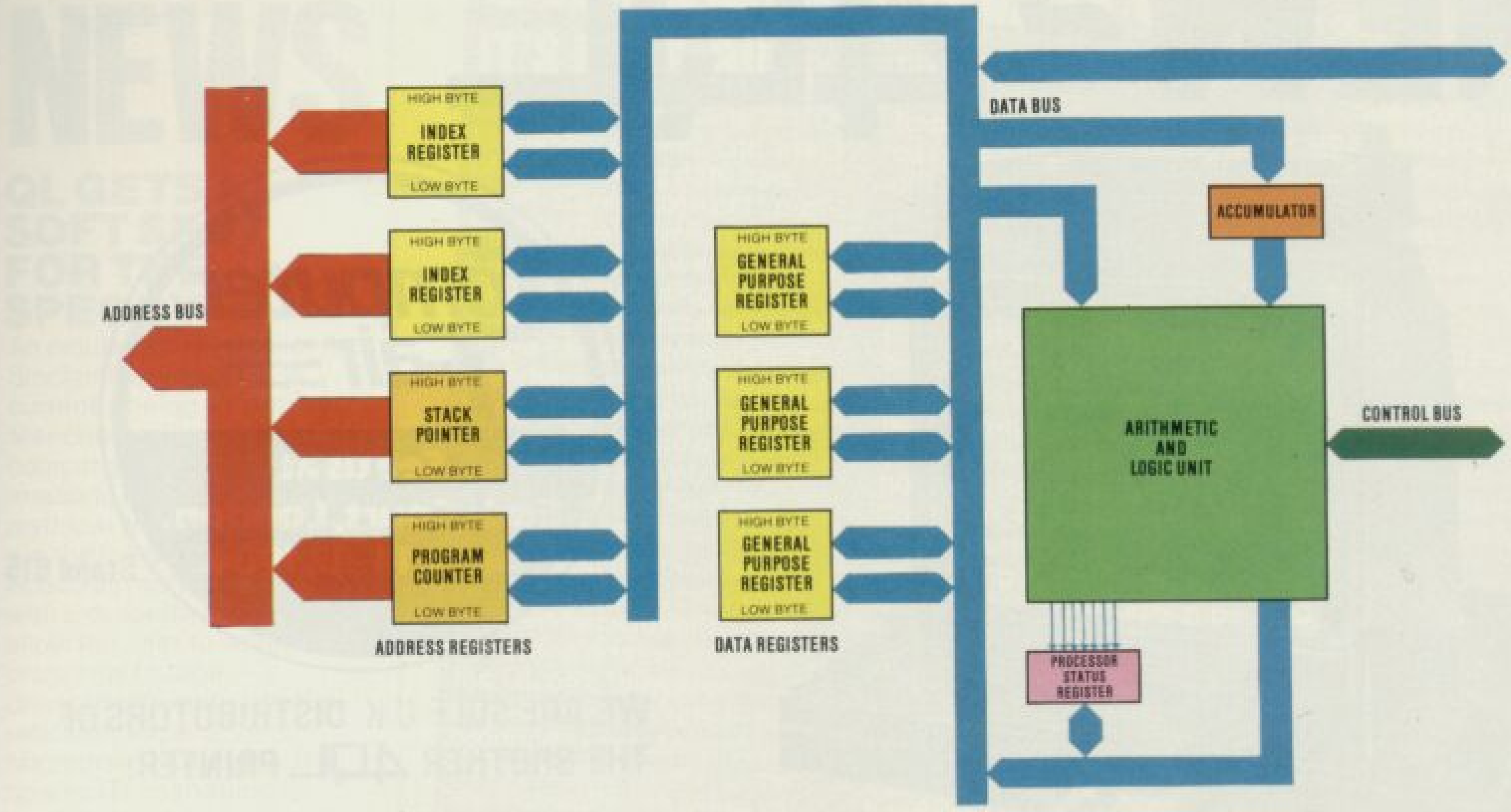
Calculations are done in the Arithmetic Logic Unit (ALU) which stores 32 bits of instructions at a time. The Stack Pointer and Program Counter keep the addresses of the areas of memory used by the ALU for program instructions and data. Although the data and address bus inside the microprocessor are 32 bits wide, the 68008 transfers 8 data bits and 20 address bits at a time to the outside world. The '8' on the end of the number stands for the number of data bits transferred at a time. Later versions of the same processor will be able to use a full 32 bit data and address bus outside the processor.

Z80 CPU
The Z80 is an extended version of the 8080 which includes a more versatile instruction set and a 'spare' set of its major registers. All the registers are 16 bits long except for the Accumulator which is 8 bits long. (The other 8 bits are used for the Status register.)

Ix and Iy are used as index registers to tables. The Stack Pointer and Program registers hold the addresses used by the ALU as its program and data stores. The Z80 is unique as it also has an Interrupt register of 8 bits (I) and a Refresh register (R). The Interrupt register holds the top 8 bits of an Interrupt address and the lower 8 bits as supplied by the device. The Refresh register counts the number of times a selected ROM is refreshed and eliminates yet another external chip.

MARK WATKINSON

Z80 CPU



PROGRAMMING PHILOSOPHY

The Z80 was designed specifically for ease of wiring up. The 68000, on the other hand, was approached from the point of view of programming simplicity; part of this ease stems from the fact that you don't have to throw away your programs when you move from one modern processor to a cheaper or faster one.

Motorola designed a range of processors, rather than a one-off. The original 68000 has spawned a number of versions with differing hardware requirements (including the so-called 'eight-bit' 68008 and the '32-bit' 68032) — but they can all run exactly the same software. This is what Sinclair Research is trying to say when it calls the QL 'future-proof'.

On a Z80, every register has its idiosyncracies; only the C register can be used to address ports, only the B register can be used in fast loops, only IX and IY can have an index, and so on. With the 68000 series, however, sets of registers work identically; each can be, for example, an index register, a stack pointer or a counter — the same instructions are available regardless of the register chosen. The data registers of the 68000 family are all 32 bits long, regardless of the way that data is passed back and forth between processor and memory (although this varies between members of the 'family').

This consistency makes it easy to learn the 68000 instruction set; you don't have to cope with all the quirks of the Z80. The symmetry also makes it easy to fix bugs, alter programs and write compilers — it's much more difficult to write a good Z80 compiler because of the vast range of special cases which must be allowed for before there's any chance of producing the best code.

A good compiler for the 68000 can produce code — from a high-level language such as 'C' — which is very nearly as efficient as hand-written code. That's how QDOS and the most popular 68000 operating system, UNIX, can be written almost entirely with a compiler rather than an assembler. Compiled programs are much easier to write and test than assembled ones.

COMPLEX INSTRUCTIONS

In theory, a 16-bit micro is twice as powerful as an eight-bit machine — it can process twice as much information in a single step. In practice, though, the difference is usually much greater, because intermediate steps are usually needed to convert two eight-bit answers into a 16-bit result. The 68008 produces the 16-bit result immediately.

The 68008 incorporates complex instructions which do in one step what for a simpler processor would take many. For instance, the 68008 can perform 32-bit multiplication and division in a single and fast step. The equivalent process would take well over a hundred steps on a Z80. The 68008 doesn't sacrifice flexibility by using its 32-bit registers — each instruction can be used in a 32-, 16- or the more concise eight-bit form.

PIPELINE PERFORMANCE

Another big difference between the 68000 family and the Z80 lies in the way the 68000 reads values from memory. The 68000, like the humble 6502, uses a technique called 'pipelining'. A processor works by fetching instructions, decoding them and then performing the appropriate actions. Whereas the Z80 performs these three actions one-by-one, the 68000 uses a completely separate unit to read instructions so that it can get on with reading the next few instructions while the rest of the processor is working out what the last one meant.

The 68008 has often been criticised because it reads and writes data in small eight-bit sections; a 'true' 16-bit processor would use larger lumps. But the difference in performance between 68000 and 68008 is much less marked than you might expect because the pipeline allows the processor to get on with fetching the data piecemeal while the instruction is being decoded. So, by the time the data is needed, it's usually in the pipeline and the 68008 doesn't have to wait for it to be fetched, eight-bits at a time.

MARK WATKINSON

QL NEWS

QL GETS A SOFT SPOT FOR THE SPECCY

An emulator program for the Sinclair Research QL is currently being written by Manchester computer company, Joe The Lion, enabling owners of the mythical wonder machine to run the full gamut of Spectrum software. It'll come with a cassette interface to allow the user to save QL programs to tape — a cheaper alternative to the relatively expensive Microdrive cartridges. But how is JTL managing to produce such a package when there aren't any QLs available?

Well, spokesman Lawrence Holt reports that a team of programmers involved in the project are "working mostly on paper", which seems to suggest that a certain amount of testing has actually taken place. But Mr Holt would neither confirm nor deny this, saying only that he didn't possess a QL. However, he did imply that it wasn't beyond the bounds of possibility that he might have access to one. £25 all-in, the likelihood is it'll be in great demand. Enquiries to JTL, telephone 061-366 7431.

RUMOURS-VILLE

Our spies report a couple of rumours currently circulating. First, a spokesman from a Midlands computer company tells us that a "private individual in the Birmingham area" is now the proud owner of one of Sinclair Research's new machines, and that this lucky laddie has been allowing a certain local manufacturer to work on the machine from time-to-time — giving a distinct commercial advantage over the rest.

The same source continued his revelations by disclosing that a close 'friend' employed on the QL project is claiming that plenty of the machines have been built and that they're just waiting for the ROMs to be completed and as soon as this has been done, they'll be plugged in and the completed units despatched — all of which sounds reasonable enough.

4 YOUR QL...

One of the on-going niggles about the QL is that it can't really be stuffed in a briefcase. So... Quantum Leap Systems has racked its corporate brain and come up with a thing called the 4QL System. It's a terminal that's specifically aimed at the executive and professional user, and it comes in a smart black unit reflecting the design of the QL. It can be used either as a desk-top peripheral base or a carrying case for the QL and its accessories.

Incorporated in the flash design is storage for up to 30 Microdrive cartridges and it opens out to provide a monitor base with three storage compartments — one for the QL when not in use, one for the cartridges (which has a drawer action) and one for the power unit and cables.

To match up with the 4QL, Quantum Leap Systems is also offering a matching black Brother HR5 printer and two 12-inch monochrome or RGB monitors in black cabinets. If you still need to be further convinced, the 4QL system will apparently be on display at The Computer Fair at Earls Court; Mr H Hadid, the Director of the company, will be on hand to answer the difficult questions. As for prices, he said, "We haven't decided on that yet — because we don't know whether we'll be selling it as a complete package or as separates. Anyway, full details will be available on the day".

However, life's not all about waiting. For even now you can purchase a Microdrive Tidy from Quantum Leap Systems. This version holds 16 Microdrive cartridges and is priced at £6.99 (including VAT and postage). You can mail order it from QLS at 68 Foxwood Close, Feltham, Middlesex TW13 7DL.

SINCLAIRWATCH

BY GUTTERSNIPE

IT'S HERE, BUT...

Only four months late, the QL has finally arrived. The latest official delivery date had been "the end of April", but Sinclair Research apparently meant that this was when its Camberley mailing house was to get its first deliveries — the early customers had their happy event a few days later, at the beginning of May. It's difficult to find out how many were delivered, but it was believed to be a few hundred at the most.

Although the number of QLs out there seems small, the number with problems occurring does not. Using the QL on a television — and even some monitors — has produced unstable pictures for many customers; some are also suffering a loss of colour. As everyone expected, the 32K ROM space has indeed proved insufficient, and an extra 9K or so (the so-called Kludge), is supplied hanging off the back.

After such delay, you'd have thought that at least the manuals would be finished — but not so. Although instructions for the Psion packages are supplied, the first customers recieved no details at all about SuperBasic or QDOS. Also missing is the page containing the pin-out for the monitor socket; so if you haven't got a TV — or the relevant page in the manual — you can't use your eagerly-awaited machine anyway. Presumably, delays with the documentation are as a result of a Basic which seemed to change almost faster than the projected delivery dates.

Another long overdue event has been the arrival of Microdrive cartridges in the shops ... you'll find them in chemists, newsagents, computer outlets, etc, etc. However, for your £4.95, you don't just get a tiny black box with 5p worth of video tape — as you do mail order — buying retail gives you, in addition, a large cardboard box, a plastic inlay, and a little notebook. Curiously, the only thing missing from the over-packaging is any mention of a guarantee or 'returns' procedure, should the thing fail.

NEW ADS FOR OLD

It seems the Advertising Standards Authority has finally got through to Sinclair Research and stopped the company advertising mail order products it cannot deliver. Instead of the old full-colour double-page ads, the QL is now being pushed via single-page black and white spots.

And the wording has been changed from that of its controversial predecessor. Instead of extolling the virtues of the the machine, nine compliment quotes from the computer press (*YS* excepted) are reproduced. They made interesting reading, particularly when you consider the comments are based not on the machine, but on its published specifications.

The fact is the QL doesn't conform very well to the original spec, and ever since the release of the machine, it's been difficult to find a good word for Sinclair Research in the computer press — partly because so few devices have been sent out for review. Some virtues are still extolled, but less excessively than before. No more are the Psion programs "more powerful than existing products costing up to £5000", and references to 'Windows' have now been reduced to plain old 'multi-display capability'.

SPOT THE PRICE

When, in the dim and distant past, the QL was first launched, provisional manuals were given out in large quantities for the press to examine. And at the back of this tome was an order form — both for the QL itself, and some of its simpler add-ons. The price for the RS232 lead was put at £10.00, and the QL Microdrives £49.95. Since the RS232 lead has been specified as a 'free gift' for those suffering the long wait, the price has strangely risen to £14.95, and the cost of the QL Microdrive to £59.95.

In fact, the first QLs are supplied with another order form, this one giving a price of £49.95 for the 'drives. You get the impression that if you order by mail, you can claim the lower price, but if you phone-in your order, it rises a tenner for the privilege.

GETTING ATTACHED
TO PRINTERS

In order to overcome the software problems of attaching a 'grown-up' printer to your Speccy,* Dilwyn Jones *sorts out how you can produce the full character set on such diverse printers as the Star Gemini 10X and the Epson FX80.

STAR GEMINI OUTPUT

The character set produced on the Star Gemini 10X.

```
  ! " # $ % & ' ( ) * + , - . /
0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z [ \ ] ↑ _
£ a b c d e f g h i j k l m n o
p q r s t u v w x y z { | } ~ ©
  ▝ ▘ ▀ ▗ ▐ ▚ ▜ ▖ ▞ ▌ ▛ ▄ ▟ ▙ █
A B C D E F G H I J K L M N O P
Q R S T U RND INKEY$ PI FN  POIN
T  SCREEN$  ATTR  AT  TAB  VAL$
 CODE  VAL  LEN  SIN  COS  TAN
ASN  ACS  ATN  LN  EXP  INT  SQR
  SGN  ABS  PEEK  IN  USR  STR$
 CHR$  NOT  BIN   OR   AND  <= >
= <>  LINE   THEN   TO   STEP
DEF FN   CAT   FORMAT   MOVE   E
RASE   OPEN #  CLOSE #  MERGE
VERIFY   BEEP   CIRCLE   INK   P
APER   FLASH   BRIGHT   INVERSE
  OVER   OUT   LPRINT   LLIST
STOP   READ   DATA   RESTORE   N
EW   BORDER   CONTINUE   DIM   R
EM   FOR   GO TO   GO SUB   INPU
T   LOAD   LIST   LET   PAUSE
NEXT   POKE   PRINT   PLOT   RUN
   SAVE   RANDOMIZE   IF   CLS
 DRAW   CLEAR   RETURN   COPY
```

Even though the character codes of many printers are different to those of the Spectrum, it's still often possible to hard copy the entire Speccy set. Taking the Gemini 10X printer, first load the tape supplied with the interface, then make the following changes (as directed by that tape) and you'll find that the printer will be able to correctly print the entire character set and listings in the Spectrum's 32-character screen format. The changes to make are as follows:

How many characters per line (80)? 32
What code for backspace (127)? "8"

Now modify the character codes for these characters when prompted:

↑	**(up arrow)**	**change to 164**
£	**(pound sign)**	**change to 195**
|	**(vertical bar)**	**change to 245**
©	**(copyright symbol)**	**change to 203**

STAR GEMINI SOFTWARE

The Basic program which sets the Star Gemini's facilities and loads the machine code.

```
  10 REM Spectrum/Star Gemini10X
  20 REM    Kempston parallel
  30 REM interface and software
  40 POKE 23609,100: REM bleep
  50 CLEAR 64735
  60 PRINT  FLASH 1:" Please wai
t... "
  70 LOAD "printcode"CODE 64736,
632
  80 CLS
  90 PRINT  BRIGHT 1: FLASH 1:"
Stop the tape "
 100 PRINT USR 65150
 110 REM get values to send to
 120 REM printer. End of data
 130 REM is 0.1
 140 RESTORE
 150 READ byte
 160 IF byte=0.1 THEN  LPRINT :
STOP
 170 LPRINT CHR$ 27;CHR$ byte:
 180 GO TO 150
 190 SAVE "GEM10X" LINE 40
 200 SAVE "printcode"CODE 64736,
632
 210 GO TO 190
 220 REM data tp set up printer
 230 REM reset printer
 240 DATA 27,64
 250 REM skip over perforation
 260 REM for 50 lines/page
 270 DATA 27,78,16
 280 REM left margin=20 chars
 290 DATA 27,77,20
 300 REM right margin=51 chars
 310 REM (line length=32 chars)
 320 DATA 27,81,51
 330 REM emphasised print
 340 DATA 27,69
 350 REM select USA character
 360 REM set, character 35=hash
 370 DATA 27,55,0
 380 REM signal end of data
 390 DATA 0.1
```

User-defined graphics A to U Change the codes to 65 (A) up to 85 (U) so that user-defined graphics come out as upper case letters (as in their undefined state on the Spectrum) rather than lower case letters.

Block graphics Fortunately, the Gemini 10X comes with Spectrum-style block graphics in its standard character set, but the codes are different to those of the Spectrum. You need to make the following changes:

Spectrum code	Printer code
28	32
29	227
30	225
31	231
32	228
33	234
34	229
35	236
36	226
37	230
38	233
39	235
40	232
41	238
42	237
43	239

Newline characters You'll be asked how many codes — combinations of carriage return (CHR$ 13), line feed (CHR$ 10), and vertical tab (CHR$ 11) — the printer needs. This depends on how the little dip switches, visible on the back of the printer, are set up. Look at the switch marked '4' — if you set it to 'on' then a line feed is performed automatically for every carriage return code received by the printer. It's up to you which to use — if it's 'on' reply 1 to the query, and if it's 'off', reply '2'. For '1' enter '13' as the code number'; for '2' enter '13' and '10'.

You've now completed this part of

GETTING ATTACHED
TO PRINTERS

the software and you should save it on tape as described in the instructions. Now type NEW to get rid of the Basic part, but do *not* switch off or do anything to erase the machine code in memory.

Now you have to enter the short Basic program which sets up several printer facilities and loads the machine code.

Having carefully checked that all numbers are correct, type GO TO 190, which will make as many copies of the software as you require. The program will auto-RUN on loading. *It would of course be very naughty to break copyright law by making unauthorised copies of the Kempston machine code software.*

When you type NEW, Stream 3 is reset to its default state to drive the ZX Printer. This is why you're told to use the RANDOMISE USR command to reinstate the printer driver software — so it's included here along with the POKE that sets up the keyboard bleep (that I find so indispensable).

When you run the program you may find that some of the characters are slightly different to those on the Spectrum; for instance, the zero is not slashed, although there is enough difference between '0' and 'O' to avoid confusion. The pound symbol looks rather weird but it's still a genuine pound sign, and the copyright symbol appears distinctly squashed. That, however, is a small price to pay for being able to print out the entire Spectrum character set on a printer of this price.

Those who are familiar with the Gemini 10X may ask why I've not made use of the 'download character set' facility. The answer is that only character codes 32 to 26 may be redefined in this mode and the other character codes above 26 cannot be used and are printed as spaces. Not all the character set can be squeezed into the 'download RAM' area.

Note that the Kempston software, like most others (including the ZX Interface 1), prints an extra space between THEN and any following keyword — it's quite normal and there's nothing yo can do about it.

Next we'll consider the case of the Epson FX80, which in its standard state is not capable of printing all of the Spectrum character set; it does, however, have full 'download character set' capabilities so a suitable set may be defined for use with the Spectrum. This has to be loaded into the FX80 every time it's switched on. As before, load the Kempston tape and make the following changes:

How many characters per line (80)? 32
What code for backspace (127)? "8"

Now modify this character code when prompted:

© **(copyright symbol)** **change to 144**

User-defined graphics A to U Change the codes to 193 (A) up to 213 (U) so that user-defined graphics are printed as upper case italic letters (user-defined graphics similarly appear as capital letters in their undefined state on the Spectrum).

Block graphics These are catered for by re-defining the printer's character set in the Basic program that follows.

Newline characters As before, these are to be set up depending on how you want the dip switches to be set up. Mine is arranged that only one code be sent to the printer, a CHR$ 13.

Now enter the Basic program which sets up the printer every time you want to use it.

After carefully checking that all the many numbers are correct, type GO TO 190 which will save the software to tape until you press the Break key. The program will now autoRUN when you load it back into the computer. I've included a sample printout of the character set from the printer. You'll notice the block graphics are different — personally I prefer them to be that way since this leads to less of a confusion on listings.

To alter them you'll need to change lines 470 to 620 of the Basic program as shown in the FX80 printer manual. YS

EPSON OUTPUT

The character set produced on the Epson FX80.

```
  ! " # $ % & ' ( ) * + , - . /
0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z [ \ ] ↑ _
£ a b c d e f g h i j k l m n o
p q r s t u v w x y z { | } ~ ©
  ▝ ▘ ▀ ▗ ▐ ▚ ▜ ▖ ▞ ▌ ▛ ▄ ▟ ▙ █
A B C D E F G H I J K L M N O P
Q R S T U RND INKEY$ PI FN  POIN
T  SCREEN$  ATTR  AT  TAB  VAL$
 CODE  VAL  LEN  SIN  COS  TAN
ASN  ACS  ATN  LN  EXP  INT  SQR
  SGN  ABS  PEEK  IN  USR  STR$
 CHR$  NOT  BIN  OR  AND  <= >
= <>  LINE  THEN  TO  STEP
DEF FN  CAT  FORMAT  MOVE  E
RASE  OPEN #  CLOSE #  MERGE
VERIFY  BEEP  CIRCLE  INK  P
APER  FLASH  BRIGHT  INVERSE
  OVER  OUT  LPRINT  LLIST
STOP  READ  DATA  RESTORE  N
EW  BORDER  CONTINUE  DIM  R
EM  FOR  GO TO  GO SUB  INPU
T  LOAD  LIST  LET  PAUSE
NEXT  POKE  PRINT  PLOT  RUN
  SAVE  RANDOMIZE  IF  CLS
 DRAW  CLEAR  RETURN  COPY
```

EPSON SOFTWARE

The Basic program which sets up the Epson FX80's facilities and loads the machine code. As in the Star Gemini software, you can SAVE the program using the command GO TO 190 — both programs will autoRUN when re-LOADed.

```
 10 REM  Spectrum/Epson FX80
 20 REM   Kempston parallel
 30 REM interface and software
 40 POKE 23609.100: REM bleep
 50 CLEAR 64735
 60 PRINT  FLASH 1:" Please wai
t... "
 70 LOAD "printcode"CODE 64736.
632
 80 CLS
 90 PRINT  BRIGHT 1: FLASH 1:"
Stop the tape "
 100 PRINT USR 65150
 110 REM get values to send to
 120 REM printer. End of data
 130 REM is 0.1
 140 RESTORE
 150 READ byte
 160 IF byte=0.1 THEN  LPRINT :
STOP
 170 LPRINT CHR$ 27:CHR$ byte:
 180 GO TO 150
 190 SAVE "EPSON" LINE 40
 200 SAVE "printcode"CODE 64736.
632
 210 GO TO 190
 220 REM data to set up printer
 230 REM reset printer
 240 DATA 27.64
 250 REM skip over perforation
 260 REM for 50 lines/page
 270 DATA 27.78.16
 280 REM left margin=20 chars
 290 DATA 27,108,20
 300 REM emphasised print
 310 DATA 27.69
 320 REM copy ROM cg fonts
 330 REM into download set
 340 DATA 27.58,0,0,0
 350 REM select download set
 360 DATA 27,37.1,0
 370 REM select ASCII 128 to 159
 380 REM and ASCII 255 as
 390 REM printable characters
 400 DATA 27,54
 410 REM data:character.attribut
e,pattern0....pattern10
 420 DATA 27,38,0,35,35,136,36.0
,255,0,36,0,255,0,36,0,0
 430 DATA 27,38,0,94,94,168,0,0.
16,32,64,191,64,32,16,0.0
 440 DATA 27,38,0,96,96,154.0.17
,0,127,128,17,128,1.128.65,1
 450 DATA 27,38,0,124,124,183,0,
0,0,0,0,126,0,0,0,0,0
 460 DATA 27,38,0,144,144,138.60
,66,153,164,129,164,129,164,129,
66,60
 470 DATA 27,38,0,128,128,138,0,
0,0,0,0,0,0,0,0,0,0
 480 DATA 27,38,0,129,129,138,25
5,0,129,0,129,0,241,0,241,0,255
 490 DATA 27,38,0,130,130,138.25
5,0,241,0,241,0,129,0,129,0.255
 500 DATA 27,38,0,131,131,138,25
5,0,241,0,241,0,241,0,241,0.255
 510 DATA 27,38,0,132,132,138,25
5,0,129,0,129,0,143,0,143,0.255
 520 DATA 27,38,0,133,133,138,25
5,0,129,0,129,0,255,0,255,0.255
 530 DATA 27,38,0,134,134,138,25
5,0,241,0,241,0.143,0,143,0,255
 540 DATA 27,38,0,135,135,138,25
5,0,241,0,241,0,255,0,255,0,255
 550 DATA 27,38,0,136.136,138,25
5,0,143,0,143,0,129,0,129,0,255
 560 DATA 27,38,0,137,137,138,25
5.0,143,0,143,0,241,0,241,0,255
 570 DATA 27,38,0,138,138,138,25
5,0,255,0,255,0,129,0,129,0,255
 580 DATA 27,38,0,139,139.138,25
5,0,255,0,255,0,241,0,241,0,255
 590 DATA 27,38,0,140,140,138,25
5,0,143,0,143,0,143,0,143,0,255
 600 DATA 27,38,0,141,141,138,25
5,0,143,0,143,0,255,0,255,0,255
 610 DATA 27,38,0,142,142,138,25
5,0,255,0,255,0,143,0,143,0,255
 620 DATA 27,38,0,143,143,138,25
5,0,255,0,255.0,255,0,255,0,255
 630 REM signal end of data
 640 DATA 0.1
```

Sinclair ZX Microdrives and ZX Interface 1

The affordable alternative to floppy discs...



...in the shops, now!

The unique ZX Microdrive system sets the ZX Spectrum apart from all other computer systems.

At a fraction of the cost of floppy discs, it gives fast access to 85K of program and data on Microdrive cartridges. And it opens up exciting possibilities through an RS232 interface and local area network.

ZX Microdrives – the fast way to save or load 85K of program and data. £49.95

ZX Microdrives are controlled by ZX Interface 1.

For their compact size, they're massively powerful. Each interchangeable Microdrive cartridge stores at least 85K of program and data!

You can create up to 50 files on the cartridge – identified by titles of your own choice.

And when you want to display the data again, Microdrives give you lightning-fast access:

- Just 3.5 seconds to access a typical file.
- Only 9 seconds to LOAD a typical 48K program.

ZX Microdrives use the Spectrum's own power supply.

Your first Microdrive is connected to Interface 1 by a Microdrive lead. Then, up to 7 more Microdrives can be added using Microdrive connectors. That gives you a minimum of 680K bytes of on-line capacity.

With memory like that, the possibilities are limitless – stock control, word-processing, even huge adventure games!

With each Microdrive, you'll receive a Microdrive connector and Microdrive demonstration cartridge. Blank Microdrive cartridges cost £4.95 each. They are available in packs of 4 (with a free cartridge wallet) or singly.

ZX Interface 1 – the multi-purpose controller. £49.95

ZX Interface 1 is a multi-purpose device. It controls up to 8 Microdrives. And it adds file-handling and communication facilities to your Spectrum.

So in one low-priced unit, you also get these two built-in features:

- **RS232 interface** This industry standard interface allows you to link your Spectrum with full-size printers, communicate with other computers employing RS232, and transmit data over telephone lines via modems.
- **The ZX Net** Now you and your friends can transfer programs and data on a local area network – or even play computer games together.

The ZX Net makes it easy, and fast!

It links between 2 and 64 Spectrums, transmitting at 10,000 characters per second. (So a full screen is transferred in around 3 seconds!) With the ZX Net, only one person need type in a program. And a Microdrive or printer can be shared by everyone in the network!

ZX Interface 1 offers you all these facilities, and retains the same peripheral port as the Spectrum itself.

With each ZX Interface 1, you'll receive a connecting lead for the first Microdrive; a ZX Net lead with jack plugs; plus a comprehensive manual.

An RS232 lead is available as an optional extra at £14.95.

Available from: larger branches of Boots • WH Smith Computer Stockists • Greens Computer Centres • Spectrum Computer Stores • and larger branches of John Menzies • Dixons • Laskys • Currys • John Lewis Partnership • Rumbelows • British Home Stores • House of Fraser and many other good computer stockists nationwide.

Find out more – in your local shop!

The best way to evaluate ZX Microdrives and Interface 1 is to see them for yourself.

There is a full range of ZX peripherals – including ZX Interface 2 for joystick and ROM Cartridge capability, alongside the only computer that supports them – the ZX Spectrum!

For more information, telephone Sinclair Research Ltd, on 0276 685311.

sinclair

SPECTRUM SOFT

'Sticks at the ready, the Chiltern Computer Club buckled down to some concentrated critique as they sifted through the latest bundle of software to give us their unbiased evaluations. Any club wishing to offer their reviewing services should contact **Ron Smith, Spectrum Soft, 14 Rathbone Place, London W1P 1DE.**

This month, the reviewers in the *YS* jury hot-seat are all members of Chiltern Computer Club, Eaton Bray, near Dunstable. They are (in alphabetical order) Simon Cox, Ian Simmonds and Jon Warner. To be honest it wasn't an easy job for them, with many of the latest offerings falling short of an acceptable level — in fact, sheer crud in some cases. Read on to find out what (and what not) to buy.

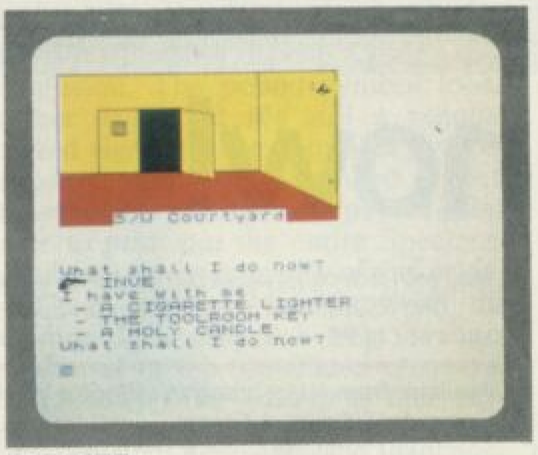
The Chiltern Computer Club was formed around two years ago, and usually it manages to attract about 35 members — ages ranging from 13 years to near senility. Membership is currently £4 per year, for which potential members can expect practical help with their computer problems, and guest speakers and lecturers from time to time.



TONY SLEEP

Those fine fellows from the Chiltern Computing Club — obviously feeling the strain of a hard day's night reviewing.

Club contacts can be made via Steve Betts, 42 Wallace Road, Eaton Bray, near Dunstable, Beds — telephone (0525) 220922. Finally thanks go to Steve for the ultra-fast speed at which he pulled the test together.



COLDITZ
Phipps Associates/£5.95

As a prisoner in the infamous Second World War camp, you must make your escape through the network of tunnels, rooms and chambers, all the time evading your captors.

Ian The quarter screen displays of the graphics locations are often very detailed, and they're drawn in approximately one second — thanks to machine code. Also very rapid is the game's response to your commands, which all goes to make this one of the more enjoyable adventures around. 6/10

Jon The colour used in this game is quite realistic, and both the drawing of locations and the command response time is surprisingly quick. 6/10

Simon The game is nicely presented, with the instructions loaded from tape. Overall, it's a well-written, well thought-out and enjoyable game. 8/10



NIGHT GUNNER
Digital Integration/£6.95

An arcade game with a Second World War scenario in which you must defend your plane against attack from enemy aircraft as you try to destroy ground targets.

Simon Some of the best features of this game are the effects, which reproduce the sounds of the plane's engine, guns firing and bombs exploding. It also includes very smooth sprite graphics and well-defined aeroplanes. 7/10

Ian This is really just another shoot-em-up game, but because this one features good old aeroplanes instead of aliens, it doesn't seem quite so unoriginal. Choice of colour is above average, as are the graphics and sound. 7/10

Jon The well-defined graphics, superb choice of colour and very playable speed, make this an excellent game to both play and watch. 8/10



KNIGHT DRIVER
Hewson Consultants/£5.95

A 'plan view' racing game in which you carefully steer the car left and right, accelerate and decelerate to keep it on the track.

Ian The speed is fast enough to make this game addictive, but it's a pity that the track only takes up about a quarter of the screen — the rest is given over to instructions, fuel gauges and so on. 4/10

Jon While the colour and speed are reasonable, the graphics are too large, and this tends to spoil the effect. But it's still a well thought-out and highly enjoyable game, with some exciting effects. 6/10

Simon It's a pity that the best use of colour happens to be on the three-quarters of the screen that contain the instructions and the instrument panel. It's an easy game to control, but difficult to win. 6/10



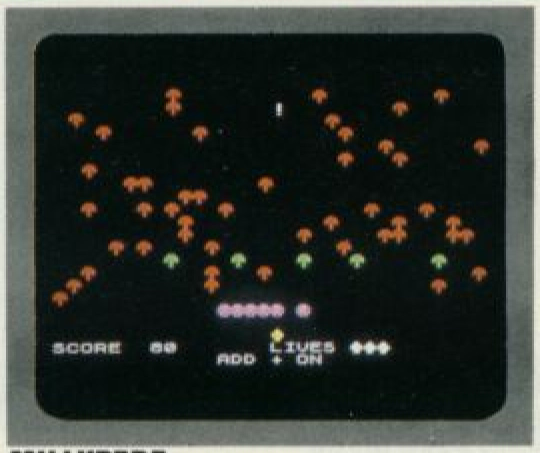
FANTASIA DIAMOND
Hewson Consultants/£7.95

An adventure in which you have to retrieve the magnificent Fantasia Diamond, a family heirloom, from the imposing fortress across the river. Now it's up to you.

Simon This one has above average graphical representation, it's fun to play, and the theme is thoroughly exciting. Good use of the Spectrum's capabilities is made even better by a very good idea. One of Hewson's best. 7/10

Jon The overall effect of well-defined graphics, and a good choice of colour is very pleasing. And you can add to that the speedy checking of commands against the large vocabulary, and rapid picture drawing. 6/10

Ian Nice use of colour, pleasant but basic graphics and quite fast. Only thing is, it seems to resemble *The Hobbit* on just a few too many occasions. 5/10



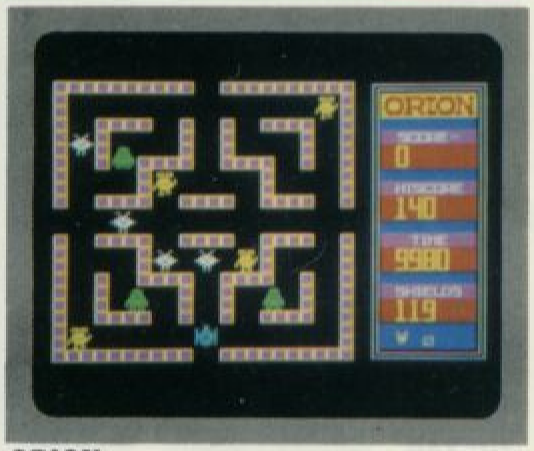
MILLYPEDE
Add On Electronics/£5.95

Another *Centipede* game in which the object is to shoot a millypede that's crawling down through a mushroom patch, all the while avoiding the spider and hitting snails for bonus points.

Simon In addition to being just another *Centipede* game, this one suffers from poor graphics and a sound output that isn't worth amplifying. However, the speed is just about right, and the choice of colours is impressive. 3/10

Jon Good overall screen effect, but the speed is perhaps a little too fast — especially the spider. Control is a bit difficult because the game control keys are too close together. 6/10

Ian Graphics definition is run-of-the-mill, and movement is one character block at a time. But the overall display is improved by the choice of colours which contrast well enough. 4/10



ORION
Software Projects/£5.95

After an attack by the Dark Horde, 100 of your Beta Class androids were kidnapped. Your mission is to rescue them from the maze of underground passages beneath the palace of Nedab, leader of the Horde.

Ian This uses well-defined sprites which move just a fraction jerkily on the left-hand side of the screen — and shows such information as score, high score and time left on the other. 7/10

Jon This game has a well laid out screen display, and the sound output is of a reasonable quality. However, the speed is a bit slow, which is a let-down. 6/10

Simon A rather uninteresting game, with poorly defined graphics and below average choice of colours, which fails to keep your attention. Rather a poor effort from the people who put out *Manic Miner.* 5/10



OLYMPIMANIA
Automata/£6.00

You, as the Pi-Man, must compete in five events at the Olympics in an effort to win as many gold medals as you can.

Jon Every screen in this totally original game is both colourful and clear, and the graphics are extremely well-defined and very smooth. Overall, a well thought-out and well representated game. 8/10

Simon Four of the events in these games are amusingly called Pi Jump, Alpi Skiing, Steepichase and Butterpi — all of which resemble one another to some extent. But with smooth, flicker-free graphics, and contrasting colours, the game is still fun. 6/10

Ian This one is fairly easy to play —only three keys are used —and the program responds quickly when they're pressed. But at times, the speed can be a little too fast, making success frustratingly difficult. 8/10



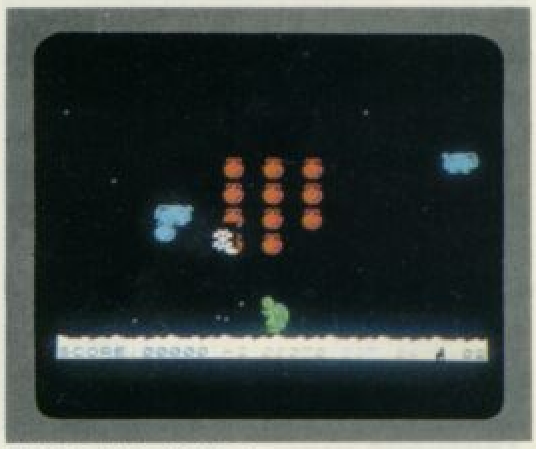
PEDRO
Imagine/£5.50

Protect your flower bed from invading bugs by jumping on them, or blocking their paths with compost or bricks. But if things get too bad, you can always plant more seeds.

Ian The well-defined sprites used in this game are sometimes difficult to make out, because the choice of colour is not always suitable. However, the game is fairly fast and there's an excellent machine code tune. 4/10

Simon The choice of colour isn't too bad, but the character movement is poor and the speed feels too slow. It gives a good impression at first, but becomes boring very quickly because although the idea is good, the execution isn't. 4/10

Jon This is a difficult game to play in the latter stages, because it gets too fast. The best part about it is the opening tune, which is very well written. 4/10



TWO GUN TURTLE
Lothlorien/£5.95

An arcade game, similar to *Pssst* by Ultimate, where you defend a strawberry patch situated in the middle of the screen from marauding bugs, by blasting them with your six-shooter.

Ian The fast smooth graphics in this game are almost of arcade quality. And the idea of a pistol packing turtle is good fun, if not original; it's been available for the Oric for some time. 4/10

Simon Good use of colour and the sprites stand out well on the background, but it's a bit too fast for the player to be successful. A reasonably addictive game that's fun to play. A supple wrist is needed for this game! 5/10

Jon The game includes some pleasing tunes, and the explosions are reproduced well. It's a very colourful game that would be improved if the graphics didn't flicker so much. 3/10



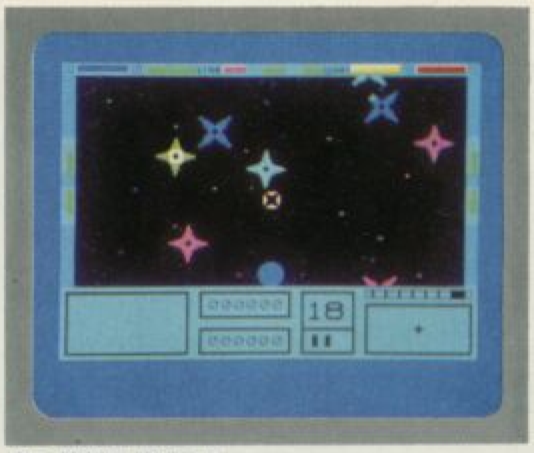
ZIG ZAG
Dk'Tronics/£5.95

A maze game with 30 screens in which you must track down androids and interrogate them for the special code that will allow you to progress to the next level.

Ian The speed is much faster than with other maze games, with drawing of the next position taking place almost instantaneously. This is really just a common-or-garden maze game, but it's still appealing and holds your attention for some time. 5/10

Simon Well executed sprite movement, playable speed and a pleasant colour selection all go to make this game fun and interesting to play. 5/10

Jon This game includes excellent 3D effects which are both smooth and well-defined. And the choice of colours is effective — they nicely complement one another. 6/10



3D STAR WARS
Custom Cables International (CCI)/£5.95

A 3D game where you take the part of Luke Clearthinker and re-enact the battle of the Jedi, taking on the entire rebel fleet on your own. This task is made easier as you have at your disposal an up-to-date star fighter.

Jon The graphics in this game are jumpy, and the colours don't contrast well. It's interesting enough to start with, but soon becomes boring because there's too much on-screen. 5/10.

Simon Colour is used fairly well, but the graphics are wobbly and don't really resemble what they're supposed to. And come to that, the idea is fairly unoriginal and uninteresting. 6/10.

Ian The game is colourful, with good 3D effects when you encounter a meteor storm. But the idea is far from original, and there's not much variation — which makes things rather tedious. 5/10.



BUBBLE TROUBLE
Arcade Software/£5.50

A maze game which involves stealing money, etc, while avoiding the pursuing bubbles whose sole aim is to suffocate you on contact.

Ian While the graphics in this game are adequate, they don't really alter very much. And the same can be said for the choice of colours which is disappointing, especially when there are 50 screens to work through. 4/10

Simon Visually, the effect is quite pleasing, with sprite movement and well-defined characters that are clearly visible — which is partly due to the choice of colours. 5/10

Jon The lowest speed level is reasonable, but the higher levels are far too slow, which is surprising when you consider the game is written in machine code. Generally, it's just another *Pacman* variation. 3/10



ARCTURUS
Visions/£6.95

A 3D noughts and crosses game, where the plot is to enslave the free world by making us devote all our incredible mental resources to solving Arcturun's ultimate mental challenge.

Jon The idea behind this game isn't bad, but it's certainly not new. Also the representation of the supposedly 3D grid is very poor. The whole thing could have been made better if the colours had been more thoughtfully selected. 3/10

Simon Something that should appeal to anyone who likes mind games, and made better by its fast response time, and reasonable use of colour. 4/10

Ian The cubes are poorly represented, and the choice of colours is very disappointing. This game's best feature is its response time but, to be honest, your time would be better rewarded with pencil and paper. 4/10



ATLAS ASSIGNMENT
Virgin Games/£5.95

Take the part of a James Bond-type spy as you work through this text-only adventure that's interspersed with three arcade games.

Ian This game responds to commands almost instantaneously, and the arcade sections are just as good. While the choice of white characters on a black background for the adventure part is quite dull, colour is well used in other ways. 7/10

Simon It's nice to see an adventure with an original theme, and making the best of some good ideas. Text-only adventures can be fun, and this one proves it. Its original theme makes it fun to play, and the overall effect is enjoyable. Very addictive. 8/10

Jon The arcade parts of this adventure are very simple, and their use of colour is limited. 6/10



CAESAR THE CAT
Mirrorsoft/£6.95

You, as Caesar the Cat, must chase mice from the well-stocked larder before they start nibbling the food, and without knocking stuff off the shelf —especially the crockery.

Ian This game makes excellent use of the Spectrum's graphics potential with huge sprites moving smoothly, without a trace of flicker. 9/10

Jon The speed is entirely suited to the style of play, with the mice getting faster as the game progresses (although the cat's speed remains constant throughout). And the bright, colourful display is so good that the overall effect looks more like a photograph than a graphics display. 9/10

Simon A highly original game for young and old alike, but it would have been nice if mews and squeaks could have been included. 9/10

RUMBLES

Our man behind the software scenes,* Ron Smith, *gets to grips with the gossip on all that's new from around the houses.



HUNT EMERSON

Anyone could be forgiven for thinking that balancing a country's economy is a difficult enough task, especially in terms of a world market. But Bug-Byte's new game pushes the player to previously unknown limits of mind-boggling supply and demand in this new 'galaxian' commodity trading game.

The game, known as *Star Trader*, features eight planets, each running an economy, and each relying on the others for trade. So it's the task of the player's alter-ego — manifested as the last remaining extra-terrestrial trader — to help these planets maintain vital supplies by making sure the goodies get from a place of plentiful supply to a not-so-fortunate neighbour. But, be warned, if you fail to trade with a planet in need, the price of the required commodity will rocket (sorry!). And if all that isn't enough, there are space pirates who demand a share of your profits (taxes); you can choose to fight them instead of paying, but in that case you'll need to buy some weapons. The game should be available mid-July.

Another project currently under wraps at BB is a, so far, unnamed little number where the player guides a person through a 3D world and views a variety of passing objects through their eyes. Says BB's Trevor Hall, "We don't know what the storyline will be yet. It could be an adventure, or perhaps like *Manic Miner*, where you have to pick up objects." But whatever the theme, the word is this game's real attraction will be its ability to show objects getting larger as they are approached, and diminishing as our character moves away from them.

One other project on BB's software mind at the moment is a program called *Twin Kingdom Valley*. It's an adventure game with over 175 different locations that's been available on the Commodore 64 for some time. The plan is to convert it to run on the Spectrum, but BB's Mr Hall isn't too optimistic. He says, "the graphics may not be possible".

ARTIC GETS THE HUMP

Those funny folk over at Artic have come up with three games, all based on a character called Humpty.

First of the trio is *Humpty Goes Walkabout*, and basically it's a new approach to a maze game. Instead of Humpty doing the running around and working himself into a bemused lather, the screen moves — and this causes the bugs and any other nasties to tumble around in haphazard fashion. Next comes *Humpty In The Garden*, where our hero's task is to make the flowers grow before the weeds strangle them. You achieve this by moving Humpty round the garden taps so he can water his precious blooms.

Third and final in this set is *Humpty The Engineer*. He has to operate all sorts of different machinery with his spanner, but unfortunately the butter-fingered buffoon keeps dropping his tool (or should it be wrench?) on to various conveyor belts. In this game of skill and timing, Hump' has to retrieve his spanner in order to keep things spinning. All three games should be coming into the shops about now.

DURELL GETS THE CHOP

Durell Software, as reported last month, recently despatched a team of programmers to Westland Helicopters to get the feel of flying in a Combat Lynx — which just happens to be the name of its latest shoot-em-up game. Well, the programmers have returned safe and sound, and are busy working out the action — a sort of cross between the usual blast-out and simulated helicopter flight.

Says Durell's Robert White, "the idea is to whizz around, laying mines in order to slow down the enemy tanks. But there are other considerations — such as not getting yourself blown to bits in the process; the combat can be either ground-to-air or air-to-air. To succeed you must be careful about weapon selection, especially as this is affected by the amount of weight a chopper can carry."

Other features include a memory-mapped battlefield containing such essential info as how high the land is at any given point, the position of the tanks and the location of the chopper. And there's also a panel at the bottom of the screen which presents various pieces of flight data to help you in your task. Watch the shops around August, when the program will be available for the 48K Spectrum, as well as the Commodore 64 and Oric Atmos.



The story so far — a screen from Durell Software's Combat Lynx. They've only managed to get the scenery scrolling so far, the helicopters and tanks still have to be implemented. Watch this space for further developments . . .

IMAGINE GETS CHAUVENIST

Another company with new releases on its corporate mind is Imagine, and this time it's out to rough it with the women's libbers out there. A new game called *BC Bill* has a highly animated caveman who's frantic to perpetuate the species, but for this he needs a woman — any woman! So, out of the cave he goes, club in hand, to begin his quest and according to Imagine's Tim Best, "The game shows women being dragged around by their hair as Bill tries to fulfil his basic ambitions." He, Tim Best that is, also fully expects, "the Greenham Common women to take up residence outside the Liverpool-based company in protest." No doubt Imagine would welcome the publicity (yuch!).

And then, of course, there's Imagine's completely new range of 'Megagames'. Supposedly, the software will be similar in style to the glittering packages offered by some American houses and will feature large, well-defined characters on-screen. They will be an environmental experience, where the player will take part in role playing games." Although Imagine is still being less than forthcoming about the finished packages (presumably because *they're* not forthcoming), it does seem as though there'll be all sorts of goodies like toys, tokens, posters, etc, that'll accompany them. These will appear in limited editions and probably become collector's items. The cost of this bracing experience will be in the £20-30 region — watch this space for further news.

CRL GETS TV TIMES

Two new programs are on the way from CRL. The first is aimed at that army of people who are always in front of you doing 25mph — learner drivers. Surprise, surprise, it's to be called *Highway Code* and the promise is it'll be "good fun and very enjoyable". Hmm. Then there's a strategy number called *Tripz* — a two-player game written especially for the Spectrum, and not just adapted from a board game version. The aim here is to surround your opponent's king or crown — chess anyone?

CRL is also in negotiations with one of the TV companies about adapting a children's program for the Spectrum. Obviously the company's not saying anything until the deal is signed, just in case any disclosure should prove prejudicial. Perhaps it's the same outfit who are talking to Dk'Troniks, whose people seem to be equally cagey. When asked if they were following the TV trend, Dk's spokesman would only say that his lips were firmly sealed. We shall see! YS

THRILLS FROM THE QUILL

After all those hours spent playing other people's adventures, the time has come to create some of your own.* Thomas Green *takes a look at the do-it-yourself package from Gilsoft.

Although the scenarios of adventure games differ widely, their worlds always comprise a series of locations and a number of objects, some of which have to be found by the player and assembled in a specified location. Hidden workings present various puzzles; in one classic adventure (said to be the granddaddy of them all) you have to catch a bird to get past the serpent, but you can't catch the bird if you're holding the black rod. Far more elaborate situations can and have been devised — the art, in fact, is to set puzzles of the right difficulty — but most of them depend on discovering combinations of objects, on carrying out appropriate actions in certain locations, or on performing specified actions within a limited number of turns.

The player controls the game by typing commands: 'GO EAST', 'GET ROD' or 'CATCH BIRD'. The computer usually replies along the lines of 'OK' or 'I CAN'T'; particular situations may evoke longer, more descripative messages — 'THE BIRD FLUTTERS AWAY FROM YOU AND SITS SINGING JUST OUT OF REACH'. As each new location is entered, the computer describes it and lists any objects (coins and jewels, for example) that may be visible. These objects can be picked up or dropped, sometimes worn, and so on.

WHAT'S ON THE MENU

Big adventures contain many hundreds or rooms and dozens of messages. They cannot be written *ad hoc*; you need a systematic approach and a database that records, for instance, which objects are where, etc. *The Quill* supplies just that. There's a convenient menu-driven database Editor, which allows you to create or amend the locations, the objects, the messages, and the events taking place in response to the player's commands. When the database is ready to be tested, the Interpreter runs the adventure, keeping track of the player's commands. Finally, when the adventure is complete it can be saved as a stand-alone program, with facilities for saving and restoring games and keeping the score.

Entities in *The Quill*'s database are linked by numbers. For instance, each message has a number; 'THE BIRD FLUTTERS AWAY FROM YOU' might be message 3. The bird itself might be object 13, and the black rod might be object 20. At the heart of the system, the Event Table will describe how to interpret the command 'CATCH BIRD'. It will do so using tests, such as PRESENT 13 ('Is object 13, the bird, present?') or NOTCARR 20 ('Is object 20 not being carried?), and actions such as MESSAGE 3 ('Print message number 3'). These are all combined in an 'Adventure' language like this:

```
CATCH BIRD
conditions:
   PRESENT 13
   NOTCARR 20
actions:
   GET 13
   OK

CATCH BIRD
conditions:
   PRESENT 13
   CARRIED 20
actions:
   MESSAGE 3
   DONE
```

The Interpreter responds to the player's command 'CATCH BIRD' by scanning the Event Table and checking the conditions for each possible interpretation of the words. As soon as it finds a possibility in which all conditions are met, the specified actions are performed.

The Event Table is supplemented by a Movement Table, which handles unconditional movements or single-word actions, such as North or its synonym 'N', and a Status Table which checks the current state after each turn, and will perform any actions whose conditions are met. Numbered flags can record past events, such as having eaten an apple; all the more interesting and unexpected parts of an adventure are likely to make heavy use of flags. There are particular flags which record the number of moves taken, whether the light is on for example, and there are a number of flags which are automatically decremeted on each turn. These might be useful, say, if the player triggers the fuse on a bomb and is allowed five turns to reach safety.

The systematic approach is clearly far better than any *ad hoc* efforts are likely to be. Moveover, the Editor makes it simple to change the text describing a location, the movements from a location, the Status and Event Tables, and so on. Hard copy on the Spectrum printer is easily produced.

Although essentially designed for text adventures, *The Quill* permits user-defined graphics and provides changes of INK and PAPER colours, bleeps, and pauses. The code is very speedy, with no waiting for even the longest room descriptions. "Well over 200 locations" are allowed, and small adventures will run in the 16K Spectrum (although *The Quill* itself needs 48K). Some of the messages from the Interpreter seemed a little ponderous and, in most instances, I would have preferred the laconic 'What now?' to the boring 'I am ready for your instructions'. The messages use 'I' by default; a special file switches to 'you', but not consistently. A pity the user can't tailor them.

THE QUALITIES OF QUILL

In its own terms, *The Quill* is without doubt exceedingly usable, with its speedy editing and testing of adventures and unusually clear documentation. While testing adventures, a diagnostic table

THRILLS FROM THE QUILL

can be displayed to show the current location and the value of each of the flags, thus you can work out why something didn't do what you expected — a facility that makes debugging a much easier task. One small quibble though: all built-in scoring is in percentage terms, which means if you add a bit more to the adventure you have to adjust the existing scores.

Working with *The Quill* certainly helps warm imagination's wings, and there's an impressively wide variety of worlds to accompany the adventure's in Gilsoft's pipeline. But, despite my admiration for the system as it stands, it tends to encourage rather 'noddy' results — mainly because the Interpreter fails to allow actions that would surely have been quite easy to include. It would have been nice, for instance, to perform an action if A is true OR if B is true; move an object from one location to another; set a flag; print the value of a flag (for example, 'YOU HAVE ONLY x TURNS LEFT BEFORE THE EXPLOSION'); change the description of a room after an event; and be able to GET any object present, without further specification (this would allow me to construct a version using single key pushes only, for younger children who can read but not yet type — if *Atic Atac* can do it, so can *The Quill*).

Although a number of these requirements cannot be met at all, some, like the OR, can quite easily be but with a clumsy and inscrutable result. Others, such as moving an object, or changing the description of a room, demand a degree of ingenuity; making an animal follow you seemed at first impossible until the mysteries were explained to me. (Hint: you have to make it both a message and an object.) Ingenuity is

A BIRD IN THE HAND

This example is a rather short adventure game based on the Bird/Rod saga in classic adventures. The game has only two rooms and two objects but serves to show the way adventures are built up. All the basic information is stored in a set of tables — messages, location descriptions, possible movements and so on. The Vocabulary table lists all the words the game understands — most of these are predefined by Quill. Finally, the actual 'program' is the Event Table which, using the other tables, dictates how the game responds to the player's commands.

VOCABULARY TABLE

```
N        1 DESC   10
NORT     1 BIRD   11
S        2 ROD    12
SOUT     2 LOOK   14
E        3 GET   100
EAST     3 TAKE  100
W        4 DROP  101
WEST     4 REMO  102
NE       5 WEAR  103
NW       6 I     104
SE       7 INVE  104
SW       8 R     105
U        9 REDE  105
UP       9 QUIT  106
CLIM     9 STOP  106
ASCE     9 SAVE  107
D       10 LOAD  108
DOWN    10
```

MESSAGE TABLE

```
MESSAGE     0
The bird futters away and sits
singing out of reach.
MESSAGE     1
You've played this before
haven't you?
MESSAGE     2
<<< CLANG !!! >>>
MESSAGE     3
Bod, that's heavy
```

LOCATION TABLE

```
Location    0
You are in a vast hall.
A tiny tunnel leads east.
Location    1
You are in a tall thin cave.
The only way out is west.
Location       0    E     TO     1
Location       1    W     TO     0
Object      0
A Black Rod
Object      1
A Cheerful little bird
```

EVENT TABLE

```
LOOK  _    Conds
           Acts   DESC
GET   BIRD Conds  NOTCARR    0
           Acts   GET        1
                  MESSAGE    1
                  OK
GET   BIRD Conds  CARRIED    0
           Acts   MESSAGE    0
GET   ROD  Conds
           Acts   MESSAGE    3
                  GET        0
                  OK
GET   I    Conds
           Acts   INVEN
DROP  ROD  Conds
           Acts   MESSAGE    2
                  DROP       0
I     _    Conds
           Acts   INVEN
R     _    Conds
           Acts   DESC
QUIT  _    Conds
           Acts   QUIT
                  TURNS
                  END
SAVE  _    Conds
           Acts   SAVE
LOAD  _    Conds
           Acts   LOAD
```

OBJECT START LOCATION TABLE

```
Object   0 at location    0
Object   1 at location    1
```

DESCRIPTIONS OF YOUR LOCATION ARE TAKEN FROM THE LOCATION TABLE. YOU START IN A VAST HALL, LOCATION 0.

THE ROD IS OBJECT 0 (LOCATION TABLE) AND STARTS OFF IN LOCATION 0 (DEFINED BY THE OBJECT START LOCATION TABLE).

You are in a vast hall.
A tiny tunnel leads east.
I can also see:-
A Black Rod

GET ROD IS LOOKED UP IN THE EVENT TABLE. THERE ARE NO RESTRICTIONS ON PICKING UP THE ROD ALTHOUGH QUILL WILL AUTOMATICALLY OBJECT IF IT'S NOT PRESENT. THE RESPONSE IS MESSAGE 3 FROM THE MESSAGE TABLE.

Tell me what to do.
>GET ROD
God, that's heavy
OK.

E USES THE MOVEMENT TABLE TO MOVE TO LOCATION 1.

Tell me what to do.
>E

You are in a tall thin cave.
The only way out is west
I can also see:-
A cheerful little bird

FIRST ATTEMPTS TO PICK UP THE BIRD ARE REJECTED. THE EVENT TABLE ENTRY FOR GET BIRD SPECIFIES THAT IF OBJECT 0 (THE ROD) IS BEING CARRIED THEN THE RESPONSE SHOULD ONLY BE MESSAGE 0.

I'm ready for your instructions.
>GET BIRD
The bird flutters away and sits singing out of reach.

ONLY WHEN THE ROD IS NOT BEING CARRIED (NOTCARR 0) WILL "GET BIRD" LET YOU PICK UP THE BIRD.

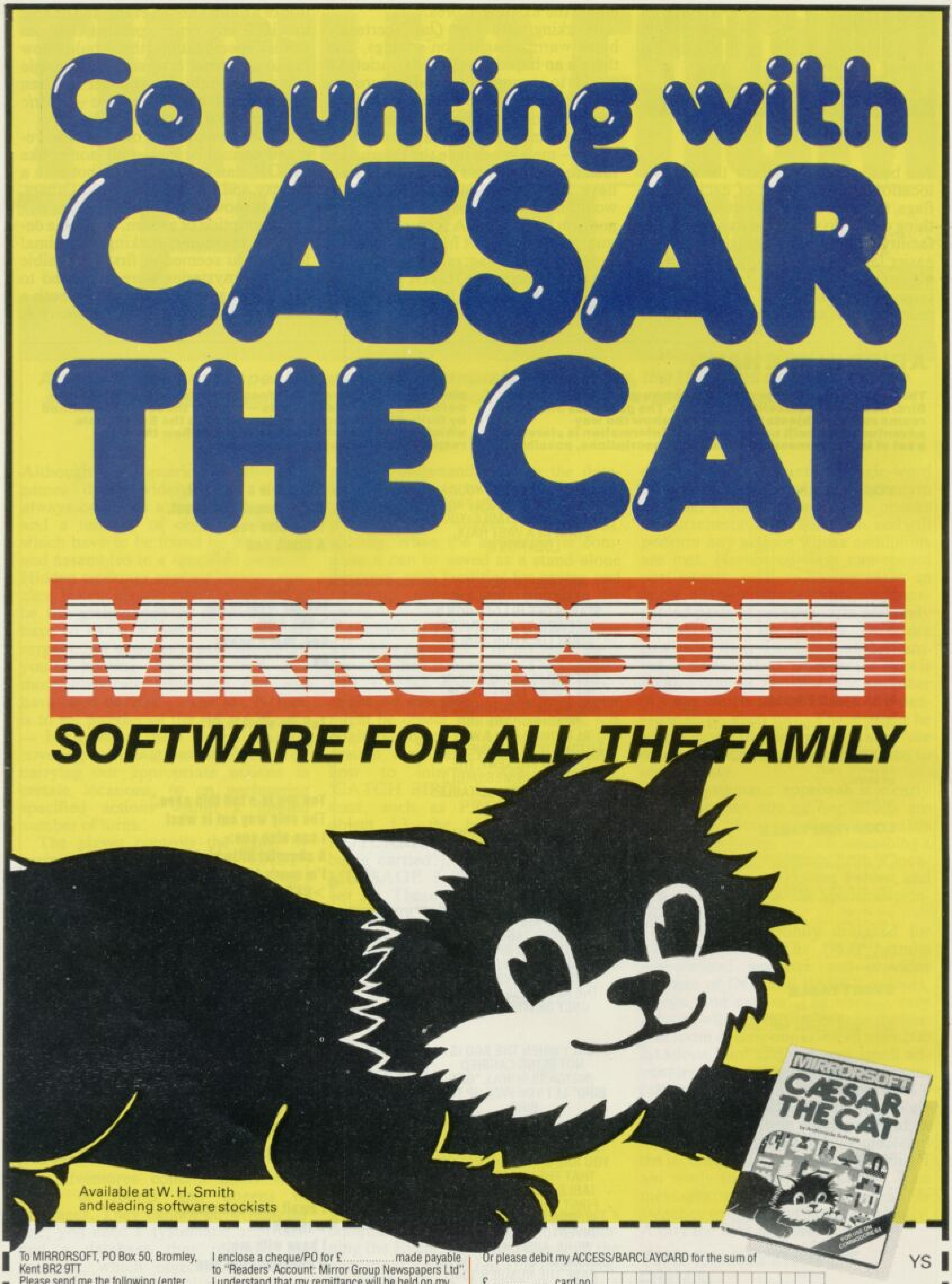
Tell me what to do.
>DROP ROD
<<< CLANG !!! >>>

I await your command.
>GET BIRD
You've played this before haven't you?
OK.

INVEN LISTS THE OBJECTS YOU ARE CARRYING. NOTICE THAT THE VOCABULARY TABLE TAKES ONLY THE FIRST FOUR LETTERS OF WORDS SO INVE, INVEN, INVENTORY WOULD ALL WORK. ALSO, INVE IS A SYNONYM FOR I (THEY BOTH HAVE THE NUMBER 104) AND IT'S ACTUALLY THE ENTRY "I —" IN THE EVENT TABLE THAT CAUSES QUILL TO EXECUTE THE INVEN COMMAND.

I await your command.
>INVEN
I have with me:-
A cheerful little bird

I await your command.
>



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THRILLS FROM THE QUILL

fun, but slow to create and sometimes tricky to debug.

These features would allow more sophisticated worlds and more interesting relationships. As it stands, *The Quill* makes it easier to hide a torch in one arbitrary place and a battery in another than to create a world with a lunatic logic; easier just to make the player die and be forced to start again than to create bizarre but comprehensible events. Two *Quill*-written adventures came with the test package — *Magic Castle* and *Diamond Trail* — and both fell into that 'Snakes and Ladders' trap.

By keeping the Interpreter language simple, however, the authors have made sure that it's highly compact and very easy to learn. It's just a question of balance.

Another problem is that despite the excellent Editor and the diagnostics for testing adventures, the *structure* of the database is not far removed from that of machine code, because of all those inflexible numbers linking things together. You can't use the command MESSAGE "HARD LUCK"; you have to store 'HARD LUCK' in the Message Table, note the message number x, and use the command MESSAGE x. Similarly, the separation between unconditional movements and conditional — handled respectively by the Movement Table and the Status Table — obscures the structure of the adventure, making it more difficult to develop interesting and unforeseen happenings — and easier to introduce inconsistencies. The problem is particularly acute with flags. Flags have numbers, not names, and their relationships are distributed through perhaps a substantial number of entries in the Event and Status Tables; these are very difficult to grasp in their entirity. The result is that new inspirations are very hard to work in while creating an adventure, and modifying an existing one is more difficult still.

In short, *The Quill* is 'first-generation'. It's a great improvement over run-of-the-mill adventure programs, but we can expect the next generation to offer increased levels of comprehensibility and modifiability. One can anticipate symbolic names for flags, a structure that allows 'events dealing with the bird and the rod' to be treated as a unit, and being able to edit the interpreter messages. And there'll be adventures for foreign-language speakers, adventures for younger children, educational adventures for teaching foreign languages, and adventures describing how to use computer packages.

Compared to the general level of software documentation, the instructions and information that accompany *The Quill* are undoubtedly excellent. A 52-page A5 booklet describes the design of a small but well-chosen adventure that exhibits most of *The Quill*'s features and explains them clearly enough for anyone to understand; it then goes on to give a detailed account of every part of the system. Grammar, punctuation, spelling and proofreading are very accurate (something it would be nice to take for granted, which is hardly the case with many manuals).

It would have been helpful had the author given novice adventurers a little more guidence in some of the recognised tricks of the trade — how to set up a maze, or how to make an animal follow the player from place to place. Gilsoft says it is considering producing a book on the craft of adventure-writing; let's hope so . . . it might make good reading.

ALL IN ALL

Setting up an adventure demands resources rather like those needed for writing programs — plus the added ingredients of creativity and wit. It also takes a long time, but if you want to give it a try then *The Quill* at £14.95 is a robust, well-documented and very usable system. But beware . . . if you thought playing adventures was addictive, just try writing them! YS

SUBCONSCIOUSNESS



Fantasise over features . . .



Marvel at machine code . . .



Revel in reviews . . .



Lust over listings . . .

If you recognise any of the critical conditions portrayed above, then you're probably a lost cause as far as computing goes — admit it, you're hooked! And, as a devout follower of Sir Clive's wonder machines, you don't want to miss out on one of the best cures around (our magazine carries no Government health warning).

You've doubtless heard the rumour that you'll always be able to take a stroll down to your local newsagents and pick up a copy of *YS*, no problem? But the fact is that *Your Spectrum* issue one sold out so fast, we're still getting calls from people anxiously pulling their hair out trying to secure a copy. Really!

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ADDING ZIP PART THREE

Following on in our epic series,* Simon Goodwin *unlocks some of ZIP's darkest secrets, as well as detailing how to add a couple of high resolution graphics commands. And there's still more to come. . .

UNZIPPING ZIP

Last month we listed the *ZIP* compiler, which converts programs in a subset of ZX Basic into fast machine code. This month we'll continue our discussion of the way *ZIP* works, and show how you can add high resolution graphics commands to the original program. The series ends next month with a fast-action game called *Star Base*, which shows just how effectively *ZIP* can speed up Basic programs.

GENERATION GAMES

We've explained that *ZIP* converts Basic into a form of 'intermediate code' which corresponds more closely with machine code, but we haven't given away many details of the translation process. That'll be put right in the next couple of pages, with a detailed example of the way *ZIP* synthesises machine code. (Skip this if you've already got a headache!)

If you've examined the listing published last month you may have been struck by the brevity of the 'code-generation' routine — about 30 lines from line 8000 onwards. In fact, only two lines — lines 8035 and 8055 — are needed most of the time. The rest handle special cases, messages to the user, and 'tweaks' to make the resultant code more efficient.

The *ZIP* code generator was deliberately kept short and simple since we decided at an early stage that it was, potentially, the 'messiest' part of the program. It's also the least portable — effort spent producing good Z80 code would be wasted when we came to convert the program for other machines, such as the QL. Machine code has lots of technicalities and special cases, and it's easy to get bogged down with code to handle all of these. *ZIP* uses a very simple protocol for code generation, to minimise the scope for confusion.

The subroutine from line 8000 onwards converts intermediate codes into machine code. It uses a library of 'templates': groups of machine code instructions which together perform a useful action, such as adding two values, printing a string or fetching the value of a variable. *ZIP* uses 60 templates to compile a large subset of ZX Basic.

Obviously some templates are 'general purpose' — it would be silly to have a different template to fetch each variable (FETCH A, FETCH B, and so on). In this case *ZIP* uses a general purpose template for all 26 variables and modifies it to handle the specific one required.

Listing 1

A pointless program in ZX Basic.

```
10 CLS
20 PRINT "Hello everyone"
30 LET X=0
40 FOR Y=166 TO 162 STEP -2
50 PLOT X,Y
60 NEXT Y
70 LET X=X+1
80 IF X=111 THEN STOP
90 GO TO 40
```

Only two values are passed into the 'code generation' routine: C, the template code (a value between one and 60); and T, an 'extra information' value used to specify specific variables, numbers, or the address of a string. Most templates ignore the value of T — they just use line 8035 to find the appropriate template, and line 8055 to copy it into place in the machine code generated by *ZIP*.

Line 8020 sifts out the templates which need extra information; line 8100 onwards is used to convert general purpose templates into specific ones. For instance, template 2 is the machine code to fetch a numeric value. In its raw form template 2 always fetches the value zero. Line 8110 modifies it to load the required value instead, by storing the value in T at 'pc-2' — over the 'zero in the general purpose template. The exact part of each template altered will vary depending upon the machine code used.

Lines 8190 to 8200 handle the printing of strings. Template 26 uses the start address of the string — supplied in T, as usual — and works out the length of the string by searching for inverted commas. Once the end has been found, it plugs the start and length into the template and stores the text of the string immediately after the template.

Listing 1 is a short program which we will more-or-less compile by hand, following the rules used by *ZIP*. The first step is to convert the program into intermediate code. This involves breaking down and re-ordering the program, to compensate for the odd order in which we humans write things. Last month we explained this process in detail — in effect, we shuffle items so that the values needed for an operation are made ready before the operation is performed. For example:

Listing 2

The same pointless program in intermediate code.

Line No.	Label	Mnemonics
LINE 10:	CLS	
LINE 20:	PR-OPEN	
	PR-STRING	("Hello everyone")
	FETCH	13
	PR-CHR$	
LINE 30:	FETCH	0
	STORE	X
LINE 40:	FETCH	166
	FETCH	162
	FETCH	-2
	FOR	Y
LINE 50:	FETCH	X
	FETCH	Y
	PLOT	
LINE 60:	NEXT	Y
LINE 70:	FETCH	X
	FETCH	1
	ADD	
	STORE	X
LINE 80:	FETCH	X
	FETCH	111
	EQUAL	
	IF	81
	STOP	
LINE 90:	GO TO	40

```
FOR Y=166 TO 162 STEP -2
```

Becomes:

```
FETCH 166
FETCH 162
FETCH -2
FOR Y
```

The second version makes more sense to a computer, which needs three values (START, END and STEP) before it can do anything with a FOR statement. Similarly, two values (X and Y co-ordinates) are needed by PLOT, which becomes FETCH X, FETCH Y, PLOT, instead of Basic's PLOT X,Y. Some operations take two values and leave one; for instance, X+Y becomes FETCH X, FETCH Y, ADD. IF X=111 becomes FETCH X, FETCH 111, EQUALS (which gives a value zero or one, depending upon whether or not X equalled 111).

Listing 2 shows the same program written as intermediate code. In each line the name of the instruction (CLS, FETCH, STORE, and so on) corresponds to a template — a value of C. The

rest of the line, be it a number, an address, or a variable name, corresponds to T, the 'extra information'.

Notice how *ZIP* has added the instruction PRINT OPEN before the PLOT and PRINT STRING. This tells the Spectrum to route information to the top of the screen (rather than the printer or the EDIT area) and resets any temporary colours. You have to perform a PRINT OPEN before you put any item on the screen, or your efforts might end up using the wrong colours or get sent to the wrong device.

Listing 3

The program in Z80 code. You'd rather type in Listing 1 than Listing 3. That's why ZIP is useful!

Line No.	Label	Mnemonics
LINE 10:		
CLS:	LD	A,2
	CALL	ROM-PR-OPEN
	CALL	ROM-CLS
LINE 20:		
PR-OPEN:	LD	A,2
	CALL	ROM-PR-OPEN
PR-STRING:	LD	DE,ZIP-TEXT
	LD	BC,14
	CALL	ROM-PR-STRING
	EX	DE,HL
	JP	(HL)
ZIP-TEXT:	DEFM	'Hello everyone'
FETCH NUM:	LD	HL,13
PR-CHR$:	LD	A,L
	RST	ROM-PRINT-A
LINE 30:		
FETCH NUM:	LD	HL,0
STORE VAR:	LD	(VARIABLE X),HL
LINE 40:		
FETCH NUM:	LD	HL,166
	PUSH	HL
FETCH NUM:	LD	HL,162
	PUSH	HL
FETCH NUM:	LD	HL,-2
FOR Y:	LD	(STEP Y),HL
	POP	HL
	LD	(END Y),HL
	POP	HL
	LD	(VARIABLE Y),HL
	LD	HL,LINE 50
	LD	(HEAD Y),HL
LINE 50:		
FETCH VAR:	LD	HL,(VARIABLE X)
	PUSH	HL
FETCH VAR:	LD	HL,(VARIABLE Y)
PLOT:	POP	BC
	LD	B,L
	CALL	ZIP-PLOT
LINE 60:		
NEXT Y:	LD	HL,(VARIABLE Y)
	LD	BC,(STEP Y)
	ADD	HL,BC
	LD	(VARIABLE Y),HL
	LD	DE,(END Y)
	OR	A
	SBC	HL,DE
	JR	Z,ZIP-LOOP
	LD	A,H
	XOR	B
	AND	128
	JR	Z,LINE 70
ZIP-LOOP:	LD	HL,(HEAD Y)
	JP	(HL)
LINE 70:		
FETCH VAR:	LD	HL,(VARIABLE X)
	PUSH	HL
FETCH NUM:	LD	HL,1
ADD:	POP	DE
	ADD	HL,DE
STORE VAR:	LD	(VARIABLE X),HL
LINE 80:		
FETCH VAR:	LD	HL,(VARIABLE X)
	PUSH	HL
FETCH NUM:	LD	HL,111
EQUAL:	POP	DE
	OR	A
	SBC	HL,DE
	LD	HL,1
	JR	Z,IF
	DEC	HL
IF:	LD	A,H
	OR	L
	JP	Z,LINE 90
STOP:	RST	ROM-ERROR
	DEFB	STOP-REPORT
LINE-90:		
GO TO:	JP	LINE 40

In principle, this 'OPEN' step is what allows the Spectrum to PRINT to the network, screen, printer, Microdrive or anything — the PRINT OPEN command is normally performed automatically by Basic's PRINT and PLOT routines, but *ZIP* must make a point of carrying that step out. The sequence FETCH 13, PR-CHR$ prints the 'new line' character at the end of the message.

Listing 3 shows the final machine code produced by *ZIP*. The listing is in Z80 machine code, with labels to indicate the start of each template.

A trick called 'peephole optimisation' has been used to remove redundant instructions from the program. *ZIP* templates use the HL registers to store temporary results. To avoid accidental loss of data, at the end of each template the result is PUSHed onto the stack so that the next template can retrieve it, if necessary, with POP HL. Quite often this leads to wasteful sequences like PUSH HL POP HL — one template stores the value, only to have the next pull it straight back again. Without peephole improvement *ZIP* would produce this code for line 30:

```
FETCH ZERO: LD HL,0
            PUSH HL
STORE IN X: POP HL
            LD (VARIABLE X),HL
```

ZIP avoids this waste of time and memory by using the variable PEEP, in lines 8050 and 8060. In line 8060 it sets PEEP if the last byte of a template is 229, a PUSH HL instruction. If the next template starts with 225 (POP HL) and PEEP was set to indicate a PUSH at the end of the last template, line 8050 deletes the last byte stored and the first byte of the next template. In this way line 70, LET X=X+1, becomes:

```
FETCH X:     LD HL , (VARIABLE X)
             PUSH HL
FETCH ONE:   LD HL, 1
ADD:         POP DE
             ADD HL, DE
STORE IN X:  LD (VARIABLE X),HL
```

Rather than the unimproved version, which shows clearly how the templates fit together:

```
FETCH X:     LD HL, (VARIABLE X)
             PUSH HL
FETCH ONE:   LD HL, 1
             PUSH HL
ADD:         POP HL
             POP DE
             ADD HL,DE
             PUSH HL
STORE IN X:  POP HL
             LD (VARIABLE X),HL
```

Notice that one PUSH HL is deliberately *not* removed from the improved version (after the FETCH X). The next instruction, FETCH ONE, does not use the value so far — it doesn't start with POP HL.

RIGHT AND ROM

Many operations can be written directly in machine code, but there are some which are very complicated or involve lots of code to handle special cases. Rather than produce hundreds of bytes of in-line code, *ZIP* performs some functions with calls to routines in the library and the Spectrum ROM. In the example program, *ZIP* uses the ROM routines CLS, OPEN, RST ERROR and PR-STRING to clear the screen, select an output channel, issue reports and print a string respectively. A *ZIP* library routine called PLOT is also used.

If need be, specific registers are loaded before the routine is called. OPEN requires a channel number in register A. PR-STRING requires the string address in DE and the length in BC; it returns with DE pointing just after the string. The byte following RST ERROR determines the report displayed.

JUMPING AND LOOPING

Intricate templates are used to handle the statements IF, FOR and NEXT. IF is converted into a test which jumps to the next line — skipping the rest of the current one — unless the result of the condition is true. The effect is like writing:

```
10 IF NOT (MARKS=100) THEN GO TO 11
   PRINT"CHEAT"
20 rest of program
```

Instead of:

```
10 IF MARKS=100 THEN PRINT"CHEAT"
20 rest of program
```

The first fragment would be impossible in normal Basic because the PRINT doesn't have a line number — but it is easy to do in machine code, which just trundles through the statements as it finds them, unless given orders to the contrary. The GO TO destination can always be 'this line plus one', since ZX Basic doesn't require GO TOs to be exact.

FOR. . .NEXT loops are more difficult to handle — in fact, many compilers process them unreliably. As we will find, even *ZIP* FOR. . .NEXT loops have their idiosyncracies!

WHAT'S IT FOR?

The FOR statement puts the START value into the appropriate variable, and makes a note of the address of the following statement (for the NEXT to go to). The END and STEP are calculated and stored for use by NEXT.

Note that when Basic encounters the FOR statement it immediately works out the values of the START, END and STEP values. A STEP of one is assumed if need be. *These values are not worked out again*, so a program such as:

```
10 LET C=5: FOR L=1 TO C: LET C=2:
PRINT"!": NEXT L
```

will print five exclamation-marks. The change in C is ignored because the END value is only calculated when the looping starts.

ZX Basic is unusual in that it checks for a start value beyond the end (greater or less, depending upon the direction of the STEP) and skips over the whole loop if such a case is found. This is a useful but rare feature, and *ZIP*, like other computer Basics, doesn't recognise that special case. *ZIP* always performs loops at least once, so you must use an IF test to jump over such loops if need be.

ADDING ZIP PART THREE

The NEXT statement retrieves the STEP, END and the address of the 'head' of the loop (the statement after the FOR). It adds the STEP (which may be negative) to the correct variable and then subtracts the END from that result. If the result is beyond the END (remember to handle negative steps again!), the program continues after the NEXT statement, otherwise it jumps back to the head of the loop.

CHEATING IS BAD!

Some compilers cheat by storing the 'head' address as part of the code of the NEXT loop. This means that the program fails if more than one FOR is associated with a NEXT, since the NEXT is 'hot-wired' so that it can only jump to one FOR.

Other compilers use the stack to store the STEP, END and 'head' values. This brings problems if Basic programmers try to RETURN out of FOR. . . NEXT loops, since the values on the stack get in the way of the return address.

Both of these cheats are allowable, in the sense that good Basic programmers won't use the same NEXT for more than one FOR, and they won't try to RETURN from the middle of a loop. Sadly, such messy programming is perfectly legal Basic, and it's a shame if compilers can't handle these special cases properly.

ZIP takes those special cases into account, but loops are still very fast — 110 times faster than Basic! The *ZIP* approach is to reserve space for an END, STEP and 'head' value for each variable name from A to Z. This ties up 156 bytes which are only used during FOR. . .NEXT loops, but it does allow programmers to RETURN and GO TO out of loops without fear of disaster. It also solves the problem of FORs outnumbering NEXTs, since each FOR stores its own 'head' value, and NEXT always uses the most recent one — just like interpreted Basic.

Using this technique, *ZIP* can even detect NEXT without FOR errors. CLEAR sets all the 'head' values to the address of the ROM error routine. If a NEXT is found before a FOR, the computer tries to jump back to what it thinks is the 'head' of the loop, and ends up in the ROM issuing a helpful report instead!

Armed with this information you should be able to understand Listing 3 — the example program in fluent, non-biological machine code. When you've digested that lot, we'll explain how we got a PLOT statement in there!

EXTENDING ZIP

One of the main design aims of *ZIP* was that it should be easy to add extra features. Listings 4 and 5 can be used to add the high resolution graphics commands PLOT and DRAW. The commands can be used almost exactly as in ZX Basic — you can specify temporary colour items such as OVER, INK and BRIGHT just as for PRINT.

Listing 4

```
7250 IF s<>246 THEN  IF s<>252 THEN  GO
TO 7260
7252 LET assmod=59+(s=252): LET c=52: GO
 SUB Z80: REM Open #2
7254 GO SUB gets: IF s>=ink AND s<=over
THEN  LET sep=s: GO SUB gets: GO SUB mat
hs: LET c=sep-189: GO SUB Z80: GO TO 725
4
7258 GO SUB maths: GO SUB gets: LET c=as
smod: GO SUB Z80: GO TO atcolon
```

The only restriction is that *ZIP* does not allow the format 'DRAW x,y, angle'. We omitted this because the ROM routine used to produce curved lines is very slow, even when called directly from *ZIP*. It's one of the parts of the Spectrum ROM written in a floating-point version of the language Forth. The equivalent machine code program would be very long, although much faster.

There are two steps involved in adding new words to *ZIP*. The first is to alter the compiler program so that it recognises the new words and treats them correctly. The second step is to alter the machine code library so that *ZIP* can generate code for the new commands.

The DATA in line 5060 tells *ZIP* whether or not a word can be compiled. The first value corresponds to the word RND, then comes INKEY$, and so on through the character table on pages 186 to 188 of the Spectrum manual. The fourth and tenth from last entries correspond to the words DRAW and PLOT respectively (CODEs 252 and 246). We must replace the appropriate 'n's in line 5060 with 'y's so that *ZIP* allows those words. Change the line so that it ends:

y,n,n,y,y,y,y,y,y,n

Instead of:

n,n,n,y,y,y,n,y,y,n

Now Pass 1 will allow the words PLOT and DRAW.

Next we alter the 'Syntax parser' used in Pass 2 so that *ZIP* can process PLOT and DRAW correctly. The new program lines to do this are shown in Listing 4. Add these lines to the copy of *ZIP* with the modified DATA statement. The first line, 7250, checks for codes 246 and 252. If either is found, line 7252 stores the request number needed by the code generator in 'assmod'. Up till now we've used request numbers one to 58. PLOT and DRAW will use requests 59 and 60. But first we set C to 52 and call Z80, which generates the code to 'open channel 2', re-setting the colour items to their 'permanent' values.

We can't generate the code for PLOT or DRAW yet since we haven't worked out the 'parameters' of the command — co-ordinates, INK, OVER, and so on. Line 7254 looks for colour items. It calls GETS to find the next symbol, and checks for symbols between INK and OVER. If one is found, it saves the symbol number and uses the 'MATHS' routine to work out the value or expression following the symbol. The calculation 'LET c=sep−189' converts the symbol into a request number. Then Z80 is called to generate the corresponding code.

The program loops at line 7254 until all of the colour items have been dealt with. Notice how MATHS is always entered with the first symbol of the expression in S. It returns with the first symbol *after* the expression (here, a semicolon) in S. The 'GETS' routine automatically skips over spaces and colour items in a program, so it's a fairly trivial matter to process a list such as 'INK 3;PAPER 4;OVER 1;' without problems.

At last *ZIP* finds a character that is not a colour item, and execution continues on line 7258. This calls the 'MATHS' routine twice, to process an X and Y co-ordinate. Then it retrieves the original request number (PLOT or DRAW) and generates the code to plot a point or draw a line. Execution continues at ATCOLON, which issues the error message 'CALCULATION NOT ALLOWED' if any symbol other than a colon or Enter is found. This detects the case 'DRAW x,y,angle' — the error message isn't very clear but it'll do.

ZIP now requests code for PLOT and DRAW, but the library still doesn't contain code to handle those commands. Listing 5 is a short program which adds extra code to the library. It should be entered and RUN while the modified version of *ZIP* is in memory. The FOR. . .NEXT loop stores the new library routines. The two GO SUB 6300s store the vectors which *ZIP* uses to find the routines.

Listing 5

```
  90 REM **** PLOT & DRAW loader
 100 LET t=0
 105 FOR i=53392 TO 53451
 110 READ d: LET t=t+d
 115 POKE i,d
 120 NEXT i
 125 IF t=7791 THEN GO TO 140
 130 PRINT "ERROR IN DATA!"
 135 STOP
 140 LET i=53365: LET t=53392: GO SUB 6300
 145 LET i=53367: LET t=53398: GO SUB 6300
 150 STOP
 200 REM
 1000 DATA 225,193,69,205,229,34,225,209
1010 DATA 205,155,208,217,229,217,203,124
1020 DATA 40,11,124,47,103,125,47,111
1030 DATA 35,38,255,24,2,38,1,203
1040 DATA 122,40,11,122,47,87,123,47
1050 DATA 95,19,22,255,24,2,22,1
1060 DATA 69,75,90,84,205,186,36,217
1070 DATA 225,217,201,1,166,211,1,190
8040 IF c=58 OR c=60 THEN LET j=4+(c=60)
```

Finally, line 8040 must be added to the 'code generation' routine. *ZIP* normally works out the length of each template by finding the address where the next one starts. The templates for PLOT and DRAW are out of order, so line 8040 bodges the 'length' value in J so that the correct length is used anyway. This is rather messy but it works, and



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ADDING ZIP PART THREE

saves us having to shuffle the entire library.

Before you try out the new code, SAVE the new versions of the compiler and library on a fresh tape, just in case you've made a typing error. Delete the code of Listing 5 (leaving line 8040 in place) and try compiling a simple line like:

```
10 PLOT 0,0: DRAW 100,100
```

If all is well, experiment with colour items. Should the computer produce odd results or crash, check that you modified the library correctly. If an error message appears, check the new lines which you have added to *ZIP* Basic.

May the *ZIP* be with you. YS

I know I stated in the first part of this article that this was to be a mere three-part series. Well, tough. Having lived with this project for the best part of six months and seen it grow from a mere hint of an idea to what I consider to be a cracking piece of code, I'm not letting you off so lightly. In the fourth part of *Adding ZIP*, I will be presenting a simple yet addictive game in ZX Basic. Yes, you've guessed it — an ideal program to *ZIP*. Catch me next month, and let the power of *ZIP* speak for itself.
Simon Goodwin

From bended kness, we at YS wish to make amends for the mess we made of last issue's *Adding ZIP* article. There's a list of the corrections in *Frontlines*, entitled 'THE DAY THE ZIP GOT ZAPPED', but if you'd like a photocopy of the article in the same condition as it left Simon's typewriter, send us an SAE and we'll bundle it off post haste.

ZIP COMPILER COUPON

If you want to save the wear and tear on your overworked fingers (not to mention your Speccy's keys), a copy of the *ZIP* compiler, library and demo program is available on cassette by post from *Your Spectrum*.

Priced at only £3.50 per copy, inc p&p, the tape includes Hi-res graphics commands, and comes complete with instructions and notes on how the program works.

To obtain your copy of *ZIP*, simply fill in the coupon below (or a photocopy if you don't want to deface your issue) and send it off without delay!

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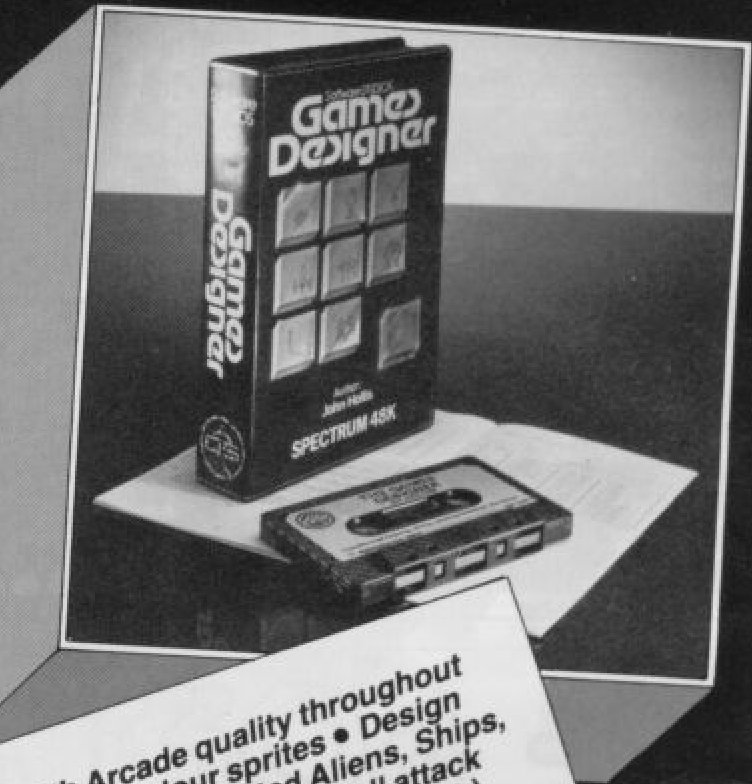
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Software might be the success story of the 'eighties, but without the hardware boffins just think where microcomputing would be. John Flenley, logic and software designer, examines the bookshelves to see just how much encouragement there is for the potential hardware freak.

HARD LINES

Sir Clive Sinclair has a lot to answer for. Apart from bringing the world digital watches and introducing a new word into the English language — 'computer window' — he's also been indirectly responsible for the publication of literally thousands of different books and magazines, examining every possible aspect of ZX computers. Someone rumoured that half the trees in the Amazon rain forests disappeared into paper mills the day the QL was announced — and I believe it!

But let's look at this paper mountain again. I said earlier, that every aspect of ZX computing had been covered, but. . . perhaps that's not quite true, for there does seem a distinct lack of books on the subject of DIY computing. The increase in availability of sophisticated hardware has not been matched (apparently) by an equivalent increase in understanding of how that hardware works. Arthur C Clarke once said, "Any sufficiently advanced technology is indistinguishable from magic", and I guess that's how a lot of people view computers — as magic boxes.

So, at the behest of our trusting editor, I decided to take a look at what books *are* available on the subject.

SPECTRUM SPECIFICS

To kick off, there's Adrian Dickens' *Spectrum Hardware Manual* published by the prolific Melbourne House. At £5.95 it has to be one of the best. The book itself is printed on good quality paper and, even better, I only found two printing errors — both of which were obvious and unlikely to mislead. Mr Dickens has a very easy-to-understand style of writing and also uses illustrations to good effect where needed. The book covers every aspect of Spectrum hardware in minute detail — what it does and how it does it. Circuit diagrams of the part under discussion are included in each chapter.

Both issue 1 and 2 machines are discussed and illustrated, and I imagine that the Mark 3 was still undergoing frantic development when this book was being written; no matter, it's just as valid for issue 3. Another chapter is devoted to fine tuning of the video circuit, something that every Spectrum probably needs. This should enable you to get rid of those stubborn colour tinges in your whites, or those striations around the edges of characters. You're also provided with a circuit diagram of a 32K upgrade, which should provide you with enough information should you decide to build your own.

Other projects to be found at the end of the book include the addition of a PIO chip, a large keyboard, a Spectrum-compatible joystick interface and an eight channel analogue-to-digital convertor. These are all well presented and ought not give any problems to the soldering iron wielder. You'll also find a complete parts list, a chapter on fault diagnosis and a full logic circuit of the Spectrum.

THE HOWS AND WHYS

The second tome I examined was *Easy Add-on Projects For Spectrum, ZX81 And Ace* by Owen Bishop. While not discussing the hardware of the Spectrum, it does outline several different build-it-yourself projects. All require you to build a separate address decoder to the circuit design given in the book. And it's here that I find my first criticism. If you're trying to teach a beginner about a subject, surely it's essential that you explain not only *how* you do something, but also *why*.

The address decoder is the basic building block of any hardware project, and the choice of address used is very important if you wish to avoid interfering with other devices attached to the micro. This is especially true for a machine like the Spectrum, where the misuse of an address line can cause havoc. The book explains very well *how* to build the decoder — no complaints there — but it doesn't give any insight into the way the author arrived at the choice of address lines. And it seemed to me that the design of the decoder itself was perhaps a little too complex, considering the fairly simple job it had to do.

Anyway, on to the actual projects. From the way the author makes good use of household items to build the various bits and pieces I get the impression that someone must be an avid fan of *Blue Peter*. The first few projects were interesting — a pulse detector (a simple device that you would find in any hobbyist kit and a good one for starting with), a small keypad, a bleeper, a model controller, a crude picture digit-



HUNT EMERSON

iser and a light pen — but as I got further into the book, I somehow felt they began to get, how can I put it, a little silly. It was as if the author had got so fed up with people saying, "Nice micro you've got there, but what does it actually *do*?", that he'd written everything he could possibly think of to build. And around this point, he seems to run out of *good* ideas.

The magnetic catch (that could be used to let the cat out in the morning) and the lap sensor for *Scalextric* cars raised a smile, the 'Heath Robinson' barometer and anemometer caused a chuckle or two — and by the time I reached the sunshine recorder and rain detector, I was rolling in the aisles. Next time someone asks you what your micro can do, tell them that with the addition of some extra hardware and a few yards of wire trailing across the garden, it can convey the news that it's raining. . . then see if they're convinced of the usefulness of a micro. Honestly, I think that the last few projects could be classified under 'Inane uses of high technology', however much they may inject a spark of humour into the book.

To be fair to the author though, all the projects are well presented, with circuit diagrams and drawings that help with the construction of associated hardware. But although enough information is given for the beginner to build a project, it would have been helpful to have included hints on what to do if the thing doesn't work when completed.

SAFETY FIRST

The third publication I looked at was Stephen Adams' *20 Simple Electronic Projects For The ZX81 & Spectrum*. Here, all the projects are interesting and have the added advantage of being ones that the hobbyist might actually want to build (maybe I *ought* to have a go at that rain detector!). Full marks to Mr Adams for his inclusion of a section on the dos and don'ts of soldering; 98 per cent of all damage caused to ICs can be attributed to faulty soldering technique and it's good to find an author stressing the point.

He goes into details on addressing, explaining what lines are safe to use and why. And each project is well covered, with adequate circuit diagrams and explanations, plus a photograph of the finished article — giving you a reasonable idea of what you're supposed to end up with. Particular projects included are: a tape recorder control; an A/D convertor; a light pen; a shift lock for keyboards; and a very useful device for turning lights on and off around the house while you're out (see, all you doubters out there. . . *that's* what a micro can do!). Then there's the mandatory burglar alarm; although no details are given on how to connect it up to a siren or alarm and, somehow, I don't see burglars fleeing in panic at the sound of the Spectrum BEEP!

There are also details on a digital voltmeter, even if the range provided — between -5v and +3.5v — gives it a rather limited use. A logic probe and standby power supply round up a goodly selection of projects. Overall, it seems an excellent book for both the beginner and the slightly more advanced hobbyist.

COLLECTIVE CIRCUITS

I'm not really sure what the next book is all about. *Sinclair Spectrum & ZX81 Add-ons* by Natasha Graham and Michael Roberts should perhaps be retitled *The Best Of Thurnall Electronics Instruction Leaflets*, because that seems to be the amount of it. The 'projects' incuded are actually programs that you can run only by using one or more (usually more) add-on units manufactured by a Manchester-based company called Thurnall Electronics. It says at the beginning that details are given on how to build the units yourself, but I'd suggest that no beginner could build anything from such sketchy information. OK, so let's assume that you *are* fairly knowledgeable on the subject of electronics and *can* actually build one of these units. What delights await you?

Well, how about the 'Disco light show', that turns eight LEDs on and off in random patterns? No? Well, then there's the visual metronome where four LEDs are turned on and off? Oh dear, you're still not impressed. Sadly, nothing much changes during the rest of the book, just chapter after chapter offering program listings enabling you to do similarly astounding things with a Variety of Thurnall units.

The advertising blurb on the back cover says, "This book shows you all you need to know as an introduction to hardware design and microcomputer interfacing" — it must be talking about another publication! At £5.95, I cannot really see it making any kind of significant impact on DIY computing.

Next in the queue came *Interfacing Microcomputers To The Real World* by Murray Sargent III and Richard L Shoemaker (what makes you think they're American?). A real epic of nearly 300 pages, it's packed with highbrow electronics and computer-based witticisms along the lines of "the trouble with computers is that they do what you tell them to, and not what you want them to do". Really, it's an excellent book, though not one for the beginner. It covers everything you could possibly want to know about digital logic and has extensive sections on the Z80 chip — including programming it — video circuitry, raster scanning, disk operating systems, and so on. If you already know the basics and are thirsting for some advanced circuitry, this is definitely the book for you.

REFERENCE READING

Finally, for those heavily into electronics there's *An Introduction To Digital Logic* by A Potton — a good, basic guide. But for minute detail of processor chips and powerful support chips, then take a look at the designer's 'Bible', the Usborne series of books titled *An Introduction To Microcomputers*. A trip to the library is recommended for these — or else you may have to sell your micro to pay for them! And you'll get similarly detailed information on most common TTL chips from the *TTL Data Book* from Texas Instruments. Texas also publishes books on linear circuits and memories. Most of these titles can be obtained from university or polytechnic bookshops, or if you're not that dedicated (or just a cheapskate) try the libraries again.

To summarise, for the beginner I would honestly recommend the Adrian Dickens and Stephen Adams books and, as you start to get more advanced — or start suffering from insomnia — the Sargent-Shoemaker tome. DIY computing is still in its infancy, but things are slowly changing and I've no doubt that sooner or later, the bookshelves of high street shops will be crammed with suitable publications. Try a little DIY. . . it's as much fun as programming!

Can anyone tell me if it's raining outside. . .? YS

WE LOOKED AT . . .

Spectrum Hardware Manual by Adrian Dickens, Melbourne House, ISBN 0 86161 1152 £5.95

Easy Add-on Projects For Spectrum, ZX81 & Ace by Owen Bishop, Bernard Babani, ISBN 0 85934 099 6 £2.75

20 Simple Electronic Projects For The ZX81 & Spectrum By Stephen Adams, Interface Publications, ISBN 0 907563 112 £6.45

Sinclair Spectrum And ZX81 Add-ons by Natasha Graham and Michael Roberts, Sigma Technical Press, ISBN 0 905104 641 £5.95

Interfacing Microcomputers To The Real World by Murray Sargent and Richard L Shoemaker, Addison-Wesley, ISBN 0 2010 077 36

An Introduction To Digital Logic by A Potton, MacMillan Press, ISBN 333 14679 4

An Introduction to Microcomputers, Usborne Press

TTL Data Book, Texas Instruments

INTERFACE ZERO

"Throw out the chips", urges **Simon Goodwin**, *as he applies the age-old formula — simple is best — to his DIY joystick interface.*

You can add a standard joystick interface to the Speccy for nothing more than the cost of some wire and a pair of plugs and sockets. The *Your Spectrum* interface explained here goes one better than Sinclair Research's one-chip Interface 2 — it uses no integrated circuits at all! Despite this, it is compatible with a wide range of software and not only that, but programs which support the Interface 2 will also work with our Interface Zero.

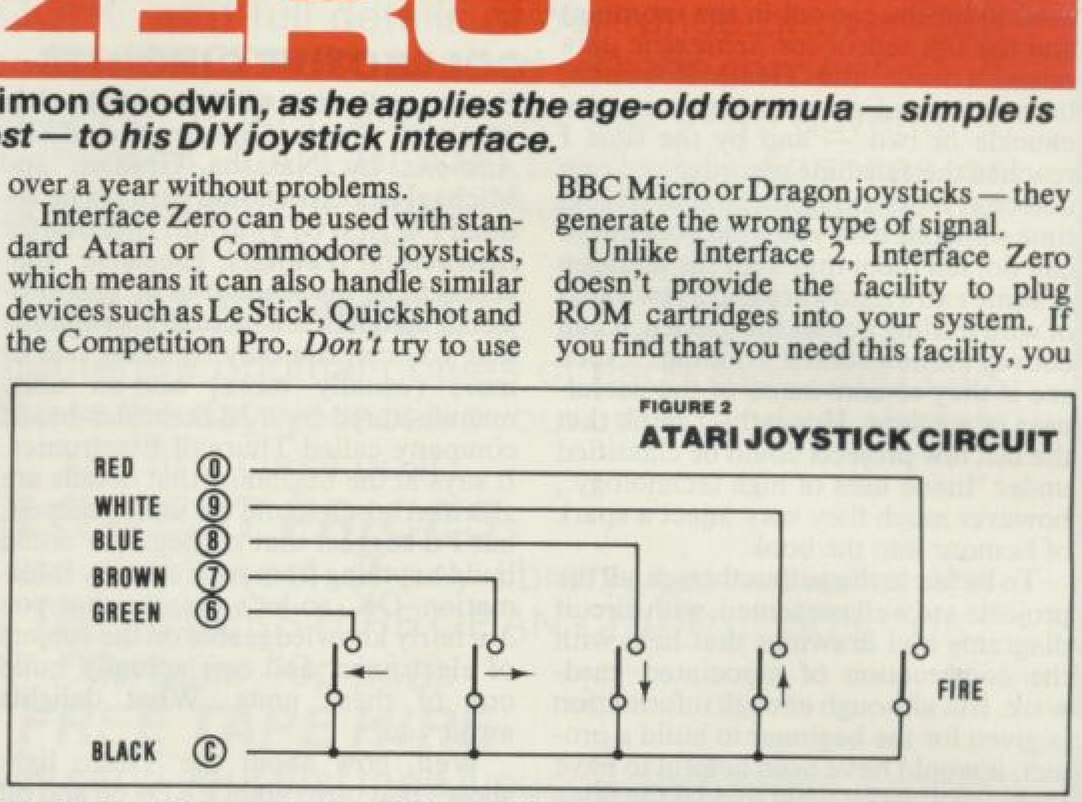
Like most hardware projects, Interface Zero requires you to make a few soldered connections inside your computer. This will void the warranty and could damage the computer too; don't attempt to wire up a joystick unless you are fairly confident about your soldering ability. Interface Zero is compatible with issue 1, 2 and 3 Spectrums, and it's been used on the author's Spectrum for over a year without problems.

Interface Zero can be used with standard Atari or Commodore joysticks, which means it can also handle similar devices such as Le Stick, Quickshot and the Competition Pro. *Don't* try to use BBC Micro or Dragon joysticks — they generate the wrong type of signal.

Unlike Interface 2, Interface Zero doesn't provide the facility to plug ROM cartridges into your system. If you find that you need this facility, you can add Interface 2 later without the need to remove Interface Zero. Like Interface 2, Interface Zero can allow a pair of joysticks for two-player games.

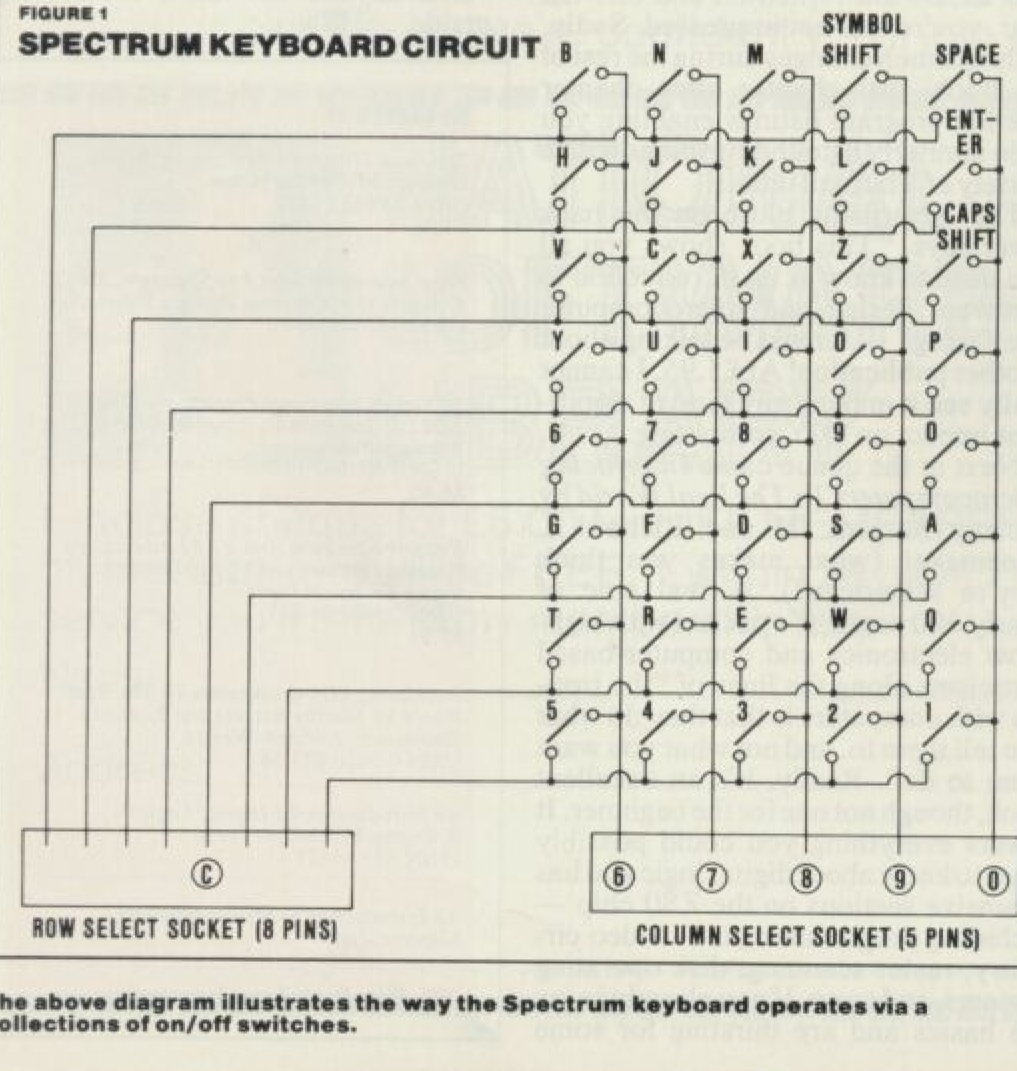
The main snag is the number of joystick 'standards' about, and programs using one system don't always allow for the others. Consequently, a joystick connected via Interface Zero won't necessarily work with games that allow a different system, such as the Kempston (port 31) or AGF (cursor keys). However, unlike the popular Kempston system, programs that allow keys to be re-defined (such as *Gold Mine* from Dk'Tronics) will work fine with the interface, and it's possible to read the joystick with the normal Basic INKEY$ function.

FIGURE 2
ATARI JOYSTICK CIRCUIT



The Atari and Commodore joysticks work like one row of a key array, with four switches for each direction and another for 'Fire'.

FIGURE 1
SPECTRUM KEYBOARD CIRCUIT

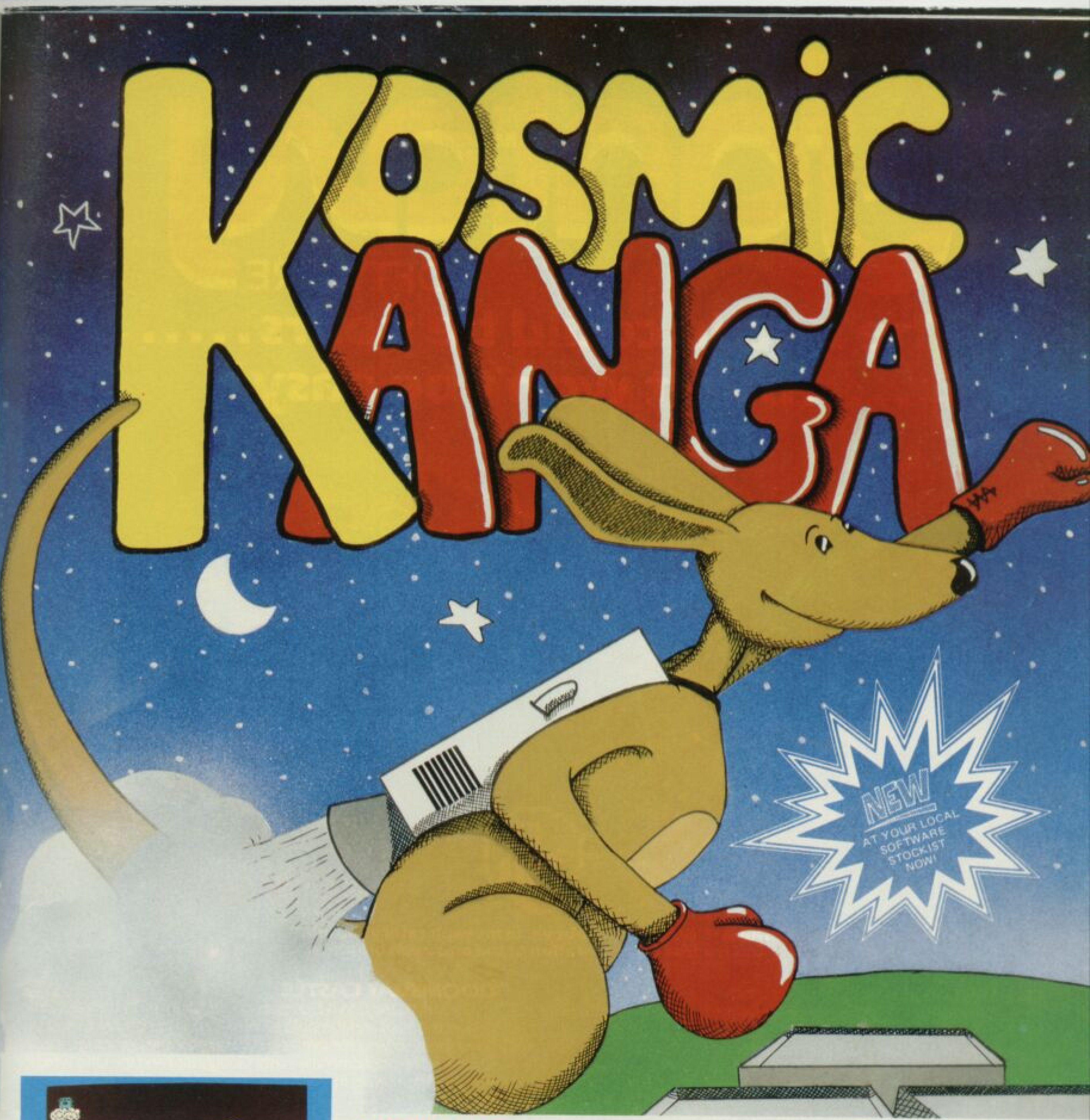


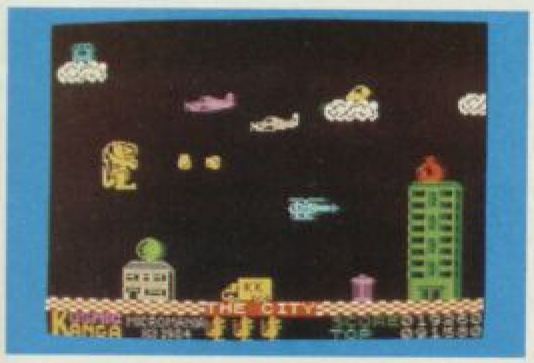
The above diagram illustrates the way the Spectrum keyboard operates via a collections of on/off switches.

HOW THE INTERFACE WORKS

Interface Zero works on a very simple principle. The Spectrum keyboard consists of a collection of on/off switches, arranged in the circuit shown in Figure 1. The physical layout is obviously different: four rows of ten keys are used, by connecting the eight rows of the circuit in pairs.

The computer periodically supplies a voltage to the 'row select' socket, energising each row of the key array in turn: if a signal makes its way out of the array





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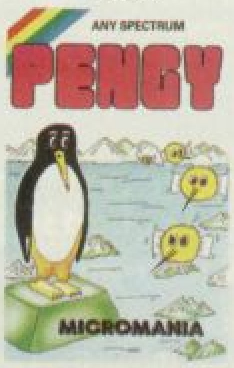
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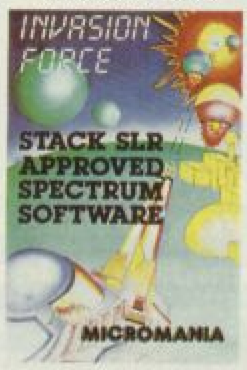
48K Spectrum

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This is 'ZIGGY', shown above, in his exploratory capsule and is a true representation of the on-screen graphics.

THE PYRAMID

THE PYRAMID is an arcade style game which has a very adventurous feel to it.

The Pyramid contains 120 chambers on 15 levels. In order to get from one chamber to another you must fight off the indigenous aliens to collect an energised crystal which will neutralize the force field guarding the two exits.

The Pyramid is inhabited by a total of 60 weird and exotic alien types, all of which are beautifully animated. You will meet a whole variety of demons, droids, insects and monsters, with a sprinkling of the more unusual, the extra-terrestrial tweezers, galactic strawberry, cosmic claw, mutant eye, plus a whole host of entities that defy rational description. You'll no doubt invent your own nicknames.

You proceed to explore the pyramid from top to bottom with the difficulty generally increasing with the depth of level. Depending on the choice of exit from each chamber you are likely to have a different game every time you play.

Apart from the challenge of trying to achieve the highest score possible the pyramid contains a number puzzle to solve. The more chambers you successfully visit the more information is gathered to enable you to discover the secret numbers of the pyramid. The puzzle won't take you days to solve, it will probably take you a few months.

DOOMSDAY CASTLE

DOOMSDAY CASTLE consists of a labyrinth of 74 complexly inter-connected Halls and Passages where you will meet a whole host of adversaries serving the infinitely evil Scarthax, the Garthrogs, the Orphacs, the phenomenally nasty Googly Bird and the Urks which manifest themselves in over fifty unbelievably weird and wonderful guises.

Scarthax has scoured the Universe to bring together the six ancient stones of lifeforce. United in Doomsday Castle they are being used to wield an irresistable power over the cosmos, emanating waves of corruption through every galaxy.

To save the Universe, you must battle your way through the Castle to find and collect the six stones and use their force against Scarthax to destroy Doomsday Castle, hopefully escaping yourself before the final cataclysmic explosion.

The task is not easy (saving the Universe never is!) and it will take you many games to unfold the structure of Doomsday Castle and discover the locations of the ancient stones.

The addictive arcade style action will keep you coming back to play but the overall challenge should still keep you occupied for months.

FANTASY SOFTWARE is available from W.H.SMITHS, JOHN MENZIES, BOOTS, LASKYS, GREENS, RUMBELOWS, SPECTRUM GROUP, COMPUTERS FOR ALL and all other good software retailers.

The Pyramid at £5.50 and Doomsday Castle at £6.50 from

FANTASY SOFTWARE, FALCONBERG LODGE, 27A ST GEORGES ROAD, CHELTENHAM, GLOS GL50 3DT
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Trade Enquiries welcome – telephone 0242-583661.

(down one of the five columns) then a key must be depressed. Since the Spectrum knows the row and column, it can thus work out which key is pressed.

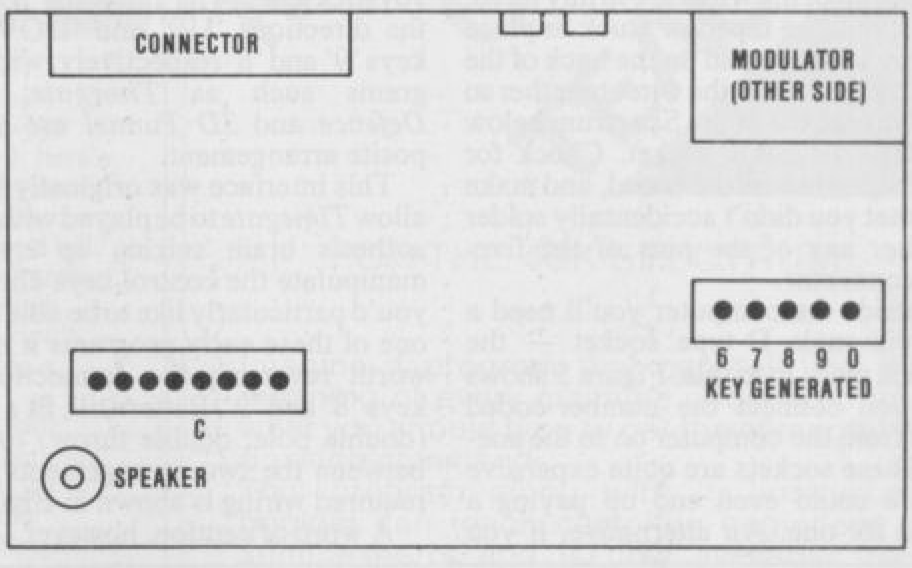
Atari and Commodore joysticks work like one row of the key array — the circuit is shown in Figure 2. A switch is used for each of four directions, with a fifth switch for the 'Fire' button. Of course, the physical arrangement of the switches in a joystick uses a cross-pattern — moving the stick simply rocks an arm on to the appropriate switch.

Sinclair Research has made things extremely simple by connecting the Spectrum keys in groups of five. To connect a joystick, all you really need to do is put the five switches of a joystick in place of one of the eight groups used by the Spectrum. It soon becomes obvious that you can connect up a joystick at the same time as the keys, without electrical problems (the computer doesn't care whether it's the key or the stick switch which is closed) — either way it registers a key-press.

The joystick will generate signals to duplicate the action of keys '6', '7', '8', '9' and '0' — we can't easily duplicate the cursor keys since these are split between two groups. The only problem remaining is how to connect it all up to the existing keyboard circuitry. The Spectrum circuit board layout was altered in each issue of the machine, changing the connection points required for the joystick: Figure 3 shows the connection points for owners of the issue 1 Spectrum, while Figure 4 matches the layout for the issue 2 and issue 3 machines.

FIGURE 4

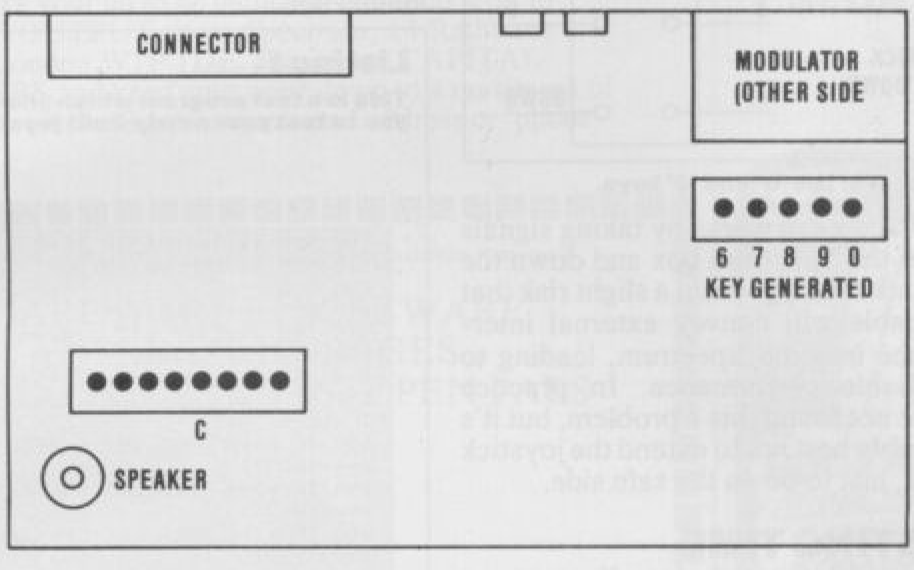
ISSUE 2 OR 3 CIRCUIT BOARD (SOLDER SIDE)



If you have an issue 2 or 3 machine you'll find the column select socket further away from the modulator — this was due to the circuit boards' re-design.

FIGURE 3

ISSUE 1 CIRCUIT BOARD (SOLDER SIDE)



On issue 1 Spectrums, the row select socket is positioned just above the speaker and the column select socket below the modulator.

OFF WITH THE LID

The first step is to open up the computer. Disconnect everything possible, then turn the machine face down. You should be able to see five black screws on the base of the computer — one by each rubber foot and the fifth at the right-hand end of the edge connector. Remove the screws with a cross-point screwdriver.

The next step is the tricky one. Without opening the case, turn the computer face up and slowly lift off the top section, until you can see the ribbon cables linking the keyboard to the electronics in the base. The cables are slotted into sockets on the circuit board — you will later solder the interface wires onto the back of these sockets.

Disconnect the keyboard by gripping the cables and pulling them evenly and squarely out of the sockets — be careful not to fold or twist the cables as you do this or you may have difficulty replacing them when you have finished. At worst you could crack the thin conductive strip on the back of the cable.

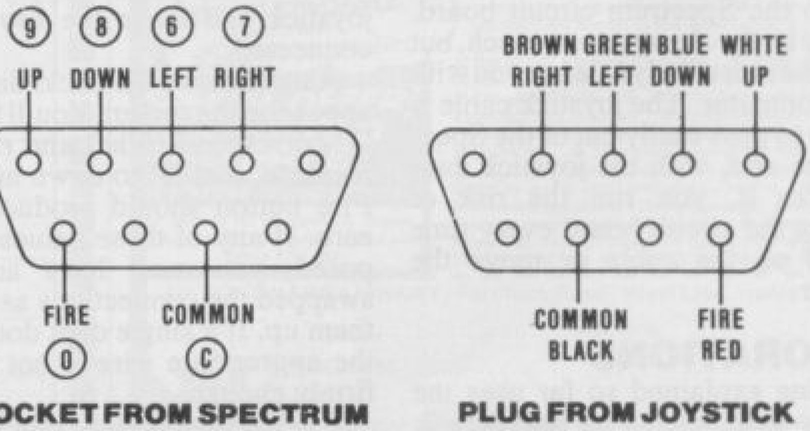
Once the cables have been unplugged, the top of the Spectrum should be completely separate from the base. Check that the cables are undamaged and then put the keyboard on one side. If the cables are cracked you may have to trim the damaged end — but be careful to cut squarely and shorten the cable as little as possible.

The circuit board is held in by a single screw in its centre. Undo this screw and lift the board from the base. Turn it over so that the solder side is uppermost and the edge connector is furthest from you. Consult Figures 3 or 4 to identify the keyboard connectors. Issue 1 machines have an add-on circuit board over the edge connector, or two empty chip sockets widely spaced along the edge connector side of the board.

Solder six wires to the points shown in the appropriate figure. Use thin insulated wire to avoid bending the circuit board. Multi-coloured ribbon cable is

FIGURE 5

JOYSTICK CONNECTOR WIRING



SOCKET FROM SPECTRUM **PLUG FROM JOYSTICK**

The 'standard' colour codes for the joystick plug and socket; if the colours differ for your particular 'stick, you'll have to dismantle it.

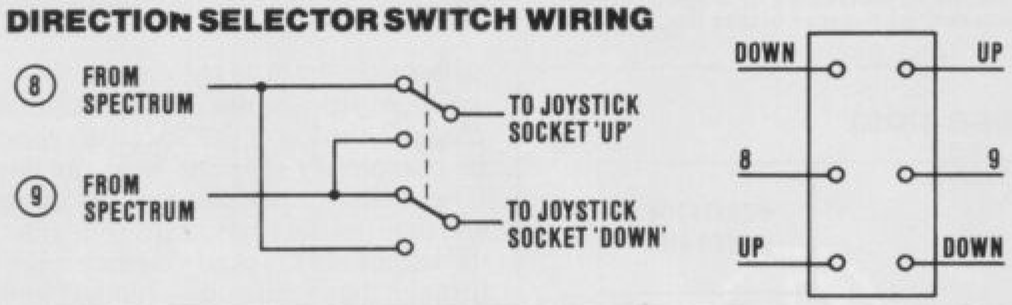
ideal; it even fits in with the Spectrum colour scheme. The common wire, marked 'C' in the figure, goes to the fifth pin of the eight-way connector. Put a little solder on the end of each wire — without frying all the insulation — before attaching to the circuit board. Use a soldering iron of *no more* than 25 watts. If a joint doesn't 'stick' at once, remove the iron, apply fresh solder, and try again after a few seconds.

Once all of the wires are firmly fixed, they should be taped or stuck in place with an adhesive pad on the back of the board. Then bunch the wires together so they can run out of the Spectrum below the MIC or EAR socket. Check for solder splashes on the board, and make sure that you didn't accidentally solder together any of the pins of the five-way connector.

Outside the computer you'll need a nine-pin male D-type socket — the joystick plugs in to this. Figure 5 shows how you connect the number-coded wires from the computer on to the socket. These sockets are quite expensive — you could even end up paying a pound for one. An alternative, if you can't afford or find a D-type socket, is to use the five pins and outer 'screen' of a DIN plug, chopping off the moulded D-type plug from the joystick and replacing it with a more common DIN plug. At a pinch you could use two pairs of stereo jack connectors, with each one carrying three of the signals.

FIGURE 6

DIRECTION SELECTOR SWITCH WIRING



A design for games players wanting to make the most of the '8' and '9' keys.

The colour codes used in the joystick plug are also shown in Figure 5. Some sticks may use a different colour code, in which case you will have to dismantle the stick (usually a simple operation, to allow for repairs) and deduce the colours used. Commodore joysticks use pink wire for 'Fire', rather than red.

We *do not* recommend that you solder the wires from the joystick directly on to the Spectrum circuit board. This may be the cheapest approach, but it's also the most likely to leave you with a dead computer. The joystick cable is too thick to pass easily out of the Spectrum case and, with the joystick dangling from it, you run the risk of damaging the circuit board every time you pull on the cable or move the computer.

ELABORATIONS

The wiring explained so far uses the same key-assignments as Interface 2. You can even fit a second joystick by connecting the common wire from it to the right-hand pin of the eight-way connector, and reversing the order of the other five wires (since keys '1' to '5' are decoded in reverse order, as you can see from Figure 1). Using Figure 1 as a guide, you can decode any of the other groups of five keys: for instance, the Q-W-E-R-T group used to control *Pssst* and *Cookie*.

Many games written before the Interface 2 was released use a similar — but not identical — arrangement of keys for Joystick One. The Interface 2 assigns the directions 'UP' and 'DOWN' to keys '9' and '8' respectively, while programs such as *Timegate*, *Earth Defence* and *3D Tunnel* use the opposite arrangement.

This interface was originally built to allow *Timegate* to be played without the author's brain seizing up trying to manipulate the control keys chosen. If you'd particularly like to be able to play one of these early programs it may be worth reversing the connections for keys '8' and '9'. Better still, fit a switch (double pole, double throw) to select between the two arrangements — the required wiring is shown in Figure 6.

A word of caution, however — since Interface Zero works by taking signals out of the Spectrum box and down the joystick cable, you run a slight risk that the cable will convey external interference into the Spectrum, leading to unreliable performance. In practice we've not found this a problem, but it's probably best not to extend the joystick cable, just to be on the safe side.

TESTING TIME

It is possible to test the interface without re-building the Spectrum, so long as you are careful to keep the circuit board away from conductive surfaces. Make one last check on your soldering and then connect the computer board to your TV and power supply. Plug in a joystick and leave the keyboard disconnected.

As you move the stick, digits should appear on the screen. You'll find '6' and '7' correspond to left and right movement, '8' and '9' to down and up. The Fire button should produce the digit zero. If any of these values are transposed, you must have accidentally swapped the connections as you wired them up. If a single digit doesn't work, the appropriate wire is not connected firmly enough.

If two adjacent digits (such as '6' and '7' or '9' and '0') don't work, you've most likely accidentally connected two of the five wires together at some point — probably by using too much solder on the circuit board. If moving the joystick has no effect at all, the common wire is disconnected. If joystick movements produce characters outside the group — '6', '7', '8', '9' and '0' — you've connected the common wire to the wrong point in the computer.

Check that the stick works reliably before re-assembling the computer, then run the joystick wire through the MIC or EAR hole, and screw down the circuit board. Position the keyboard over the base and push the ribbon cables firmly and evenly into the sockets on the top of the board, making sure that they are not twisted. Don't force the cables — when correctly positioned they should plug in securely with little resistance. Turn the computer over and replace the five screws in its base (assuming you haven't lost them).

TEST PROGRAM

Listing 1 is a test program which allows you to steer a character arond the screen with the joystick. The colour of the character changes when the Fire button is pressed. Notice that the program uses the IN command rather than INKEY$. IN allows it to detect instances when more than one key is depressed (as in diagonal movement). You can still use the relevant keys to control the character, even when the joystick is connected.

Listing 1.

This is a test program which allows you to test your newly-built joystick.

```
100 REM ** INTERFACE ZERO
110 REM ** DEMONSTRATION
120 CLS
130 LET x=16: LET y=10
140 LET oldx=x: LET oldy=y
150 LET k=IN 61438
160 LET k=31+INT (k/32)*32-k
170 IF k>=16 THEN LET k=k-16: L
ET x=x-(x>0)
180 IF k>=8 THEN LET k=k-8: LET
x=x+(x<31)
190 IF k>=4 THEN LET k=k-4: LET
y=y+(y<21)
200 IF k>=2 THEN LET k=k-2: LET
y=y-(y>0)
210 INK k+k
220 PRINT AT oldy,oldx;" "
230 PRINT AT y,x;"*"
240 GO TO 140
```

Most of the program is straightforward, although lines 150 and 160 may cause confusion. The IN function reads the keys, giving their status in the bottom five bits of 'K'. A bit is RESET (zero) if the corresponding key is depressed. Line 160 sets bits five, six and seven to zero (the INT expression), and inverts the remaining bits by taking the remainder away from 31. For further information look at Chapter 23 of the Spectrum manual.

IN CONCLUSION

Follow these instructions carefully and you'll find you have added a joystick to your Spectrum for a fraction of the price most firms are asking for adaptor units. *Bon chance!* YS

INPUT/ OUTPUT

Once again, we're throwing out the pages of *Your Spectrum* for a worthy cause. Like most of us, you've probably got loads of odd bits of hardware and software around your bedroom that just gets in the way. Well, here's a way to solve your problems. . . and get something you want into the bargain.

Simply fill in the form at the bottom of the page and tell us in not more than 30 words what you've got up for grabs and just what you want in return. Try and give as much information as you can within the 30-word limit — don't worry about your address if it's too long, just provide a 'phone number you can be reached on.

Of course, this isn't just limited to swopping software, you can also publicise your club or advertise for a pen pal. Just give a rough idea of your interests and let them get in touch with you — could be you'll find a friend for life!

There'll be no charge for anything placed in the magazine — just keep it relatively clean (the Editor has to read all the entries, you know) and keep 'em coming! We like to know we've got some interested readers out there. . .

Fill in the form below, specifying in which category you'd like your ad to be included, and send it off to INPUT/OUTPUT, *Your Spectrum*, 14 Rathbone Place, London W1P 1DE. Please use CAPITAL LETTERS and keep your copy down to a maximum of 30 words (including your name and address or 'phone number).

Use a photocopy of this form if you don't want to deface your issue.

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PROGRAM POWER

This month's Program Power features just one program — and it's been written at the keys of our very own* Peter Shaw*. Complete with all the thrills and spills of a fruit machine,* Peter *has managed to cram in a few extras as well.

KATAPILLA KRAZY

BY PETER SHAW (48K)

If you're a fan of the old one-armed bandits (if you can remember them that is!) you're going to love this program. Play is simple but addictive and extremely colourful use is made of the Spectrum's display.

Dead centre of the screen is the window to the action. This is the equivalent of the wheels that tumble within the fruit machine and comes up with a new line of objects and fruits each time you set the wheels in motion. The particular piece of code to operate these 'wheels' has been written in Basic, but if any of you out there fancy converting the routine to machine code you'll much improve the game. Incidently, Peter would be very pleased to hear your suggestions as to how this can be done as he didn't quite manage to come up with the goods by the deadline *(Life isn't a line of cherries. Ed.)*.

On the left-hand side of the screen is a graphic representation of what you can win providing you come up with the right lines on the centre window. To the right of the centre display are the boxes for the 'gamble' routine, which will be explained later.

The boxes at the bottom of the screen provide you with an indication of the options open to you, such as 'Feature Hold', 'Hold', 'Collect', 'Gamble', and so on. You'll get the idea once you get the program working. Up at the top is the Krazy Katapilla, which can be made to 'grow' until it reaches the right-hand side of the screen and hits the £2 symbol — no prizes for guessing what happens then!

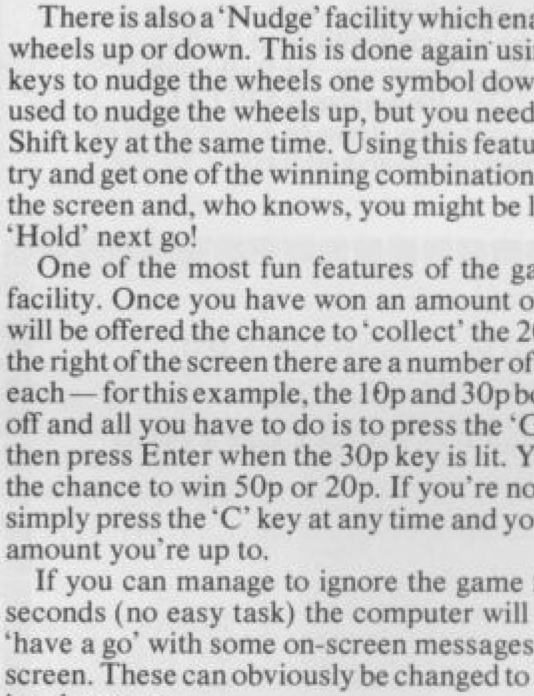
You start off the game with 10 credits, each worth 10p. Press Enter to start the wheels spinning and one credit will be subtracted from your rating. When each of the wheels has stopped, you will be notified if you have won anything and the Krazy Katapilla at the top of the screen will move a certain distance towards the £2 symbol. If you are lucky enough to gain a 'Feature Hold' facility, the Krazy Katapilla will stay where it is and the next score will be added to its length; if not, it goes back to the start for your next turn. Should you get the message 'Hold' flashing at you on-screen, you can hold any or all of the wheels with the '1', '2' and '3' keys respectively.

There is also a 'Nudge' facility which enables you to move the wheels up or down. This is done again using the '1', '2' and '3' keys to nudge the wheels one symbol down; the same keys are used to nudge the wheels up, but you need to press the Symbol Shift key at the same time. Using this feature carefully, you can try and get one of the winning combinations shown on the left of the screen and, who knows, you might be lucky enough to get a 'Hold' next go!

One of the most fun features of the game is the 'Gamble' facility. Once you have won an amount of cash, say 20p, you will be offered the chance to 'collect' the 20p or try for 30p. On the right of the screen there are a number of boxes with figures in each — for this example, the 10p and 30p boxes will flash on and off and all you have to do is to press the 'G' key to gamble and then press Enter when the 30p key is lit. You'll then be offered the chance to win 50p or 20p. If you're not the gambling type, simply press the 'C' key at any time and you'll collect whatever amount you're up to.

If you can manage to ignore the game for more than a few seconds (no easy task) the computer will begin egging you to 'have a go' with some on-screen messages at the bottom of the screen. These can obviously be changed to suit whoever is playing the game.

A note for those about to type it in — all the graphics characters are listed as lower case letters and all lower case letters are graphics characters. Got it? Well, go on, get on with it!



Dead centre of the screen are the 'wheels' which come up with a line of fruit and objects when you press Enter. To the left of the screen are the possible winning combinations, to the right are the 'Gamble' boxes. At the bottom of the screen is where you'll find all the messages to help you play the game.



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```
10 BORDER 0: REM
 @ P.SHAW/SPORTSCENE 1984
20 REM KRAZY KATAPILLA
30 REM @ PETER SHAW 1984
40 POKE 23658,8
```

Lines 10-40 Set up the BORDER colour and switch the keys to Caps Lock.

```
 50 GO SUB 2520
 60 INPUT ""
 70 PRINT AT 3,10; PAPER 5; INK 0;"YOUR
 SPECCY!"
 80 PRINT AT 16,21; PAPER 8; INK 9;"CRE
DITS"
 90 PRINT AT 15,23; INK 9;"000"
```

Lines 50-90 The 'screen set-up' routine.

```
100 GO SUB 1660
101 PRINT AT 0,0; PAPER 0; INK 4;"ttu"
110 LET CRE=CRE-1: IF CRE=-1 THEN  INPU
T "NO CREDIT-PRESS ENTER FOR MORE "; LIN
E A$: GO TO 10
```

Lines 100-110 Finish off the screen layout and check the number of credits you have left.

```
120 PRINT AT 15,23; PAPER 8;("0" AND CR
E<10)+("0" AND CRE<100);CRE
130 GO SUB 1210
140 GO SUB 1320
150 IF NC=1 THEN  LET NC=0: GO TO 170
160 GO SUB 860
170 GO TO 110
```

Lines 120-170 The main calling loop. This routine calls all the subroutines for the general running of the program.

```
180 LET FH=1: PRINT AT 18,19; PAPER 8;
INK 9;"FEATURE HOLD"
190 PRINT AT 16,12; FLASH 1; INK 8; PAP
ER 8;"ab"
200 PRINT AT 16,15; FLASH 1; INK 8; PAP
ER 8;"ab"
210 PRINT AT 16,18; FLASH 1; INK 8; PAP
ER 8;"ab"
220 IF INKEY$=CHR$ 13 THEN  RETURN
230 IF INKEY$="1" THEN  LET T(1)=1: PRI
NT AT 16,12; PAPER 8; INK 8;"cb"
240 IF INKEY$="2" THEN  LET T(2)=1: PRI
NT AT 16,15; PAPER 8; INK 8;"cb"
250 IF INKEY$="3" THEN  LET T(3)=1: PRI
NT AT 16,18; PAPER 8; INK 8;"cb"
260 IF INKEY$="C" THEN  LET T(1)=0: LET
 T(2)=0: LET T(3)=0: GO TO 190
270 GO TO 220
```

Lines 180-270 The 'Hold' routine, which includes the 'Feature Hold' routine.

```
280 FOR R=1 TO INT (RND*10)+10
290 PRINT AT 20,16; PAPER 8; INK 9; FLA
SH 1;"NUDGE"
300 IF IN 32766=253 THEN  PRINT AT 20,2
2; PAPER 8; INK 8;"UP"
310 IF IN 32766<>253 THEN  PRINT AT 20,
22; PAPER 8; INK 8;"  "
320 LET B=0
330 IF INKEY$="!" THEN  LET B=1: FOR A=
1 TO 3: LET J(1,A)=J(1,A)+1: IF J(1,A)=1
6 THEN  LET J(1,A)=1
340 IF B=1 THEN  NEXT A: GO SUB 1210
350 LET B=0
360 IF INKEY$="@" THEN  LET B=1: FOR A=
1 TO 3: LET J(2,A)=J(2,A)+1: IF J(2,A)=1
6 THEN  LET J(2,A)=1
370 IF B=1 THEN  NEXT A: GO SUB 1210
380 LET B=0
390 IF INKEY$="#" THEN  LET B=1: FOR A=
1 TO 3: LET J(3,A)=J(3,A)+1: IF J(3,A)=1
6 THEN  LET J(3,A)=1
400 IF B=1 THEN  NEXT A: GO SUB 1210
410 LET B=0
420 IF INKEY$="1" THEN  LET B=1: FOR A=
1 TO 3: LET J(1,A)=J(1,A)-1: IF J(1,A)=0
 THEN  LET J(1,A)=15
430 IF B=1 THEN  NEXT A: GO SUB 1210
440 LET B=0
450 IF INKEY$="2" THEN  LET B=1: FOR A=
1 TO 3: LET J(2,A)=J(2,A)-1: IF J(2,A)=0
 THEN  LET J(2,A)=15
460 IF B=1 THEN  NEXT A: GO SUB 1210
470 LET B=0
480 IF INKEY$="3" THEN  LET B=1: FOR A=
1 TO 3: LET J(3,A)=J(3,A)-1: IF J(3,A)=0
 THEN  LET J(3,A)=15
490 IF B=1 THEN  NEXT A: GO SUB 1210
500 LET NC=1
510 PRINT AT 20,16; PAPER 8; INK 8;"
 ";AT 20,22;"  "
520 LET B=0
530 FOR A=1 TO 40 STEP 12: BEEP .001,A:
 NEXT A
540 FOR A=1 TO 10: NEXT A
550 IF R(1,J(1,1))=R(2,J(2,1)) AND R(2,
J(2,1))=R(3,J(3,1)) AND V(R(1,J(1,1)),2)
<>0 THEN  LET PR=V(R(1,J(1,1)),2): GO TO
 990
560 IF R(1,J(1,1))=R(2,J(2,1)) AND V(R(
1,J(1,1)),1)<>0 THEN  LET PR=V(R(1,J(1,1
)),1)<>0: GO TO 990
570 PRINT AT 20,16; PAPER 8; INK 9;"NUD
GE"
580 NEXT R
590 PRINT AT 20,26; PAPER 8; INK 8;"
 "
600 RETURN
```

Lines 280-600 The 'Nudge' routine. Notice that in lines 300 and 310, the IN function has been used to detect if the Symbol Shift key is being pressed (shown by printing 'UP' in the 'Nudge Status' window).

```
610 PRINT AT 20,1; PAPER 8; INK 9;"COLL
ECT";AT 20,9;"      "
620 PAUSE 2: IF INKEY$="C" THEN  GO TO
1030
630 PRINT AT 20,1; PAPER 8; INK 9;"
 ";AT 20,9;"GAMBLE"
640 PAUSE 2: IF INKEY$="G" THEN  GO TO
660
650 GO TO 610
660 LET PS=PR/10: LET COL=0
670 IF INKEY$<>"" THEN  GO TO 670
680 IF PR=100 THEN  LET PS=5
690 IF PR=50 THEN  LET PS=4
700 PRINT AT P(PS,1),P(PS,2); OVER 1; P
APER 8; INK 8; BRIGHT 1;"  "
710 PRINT AT P(PS-1,1),P(PS-1,2); OVER
1; PAPER 8; INK 8; INVERSE 1;"  ";AT P(P
S+1,1),P(PS+1,2); INVERSE 0;"  "
720 IF INKEY$<>"" AND INKEY$<>"C" THEN
 LET PS=PS-1: PRINT AT P(PS,1),P(PS,2);
OVER 1; INK 8; PAPER 8; INVERSE 0;"  ":
LET COL=1: GO TO 770
730 PRINT AT P(PS+1,1),P(PS+1,2); OVER
1; PAPER 8; INK 8; INVERSE 1;"  ";AT P(P
S-1,1),P(PS-1,2); INVERSE 0;"  "
```

fantasy

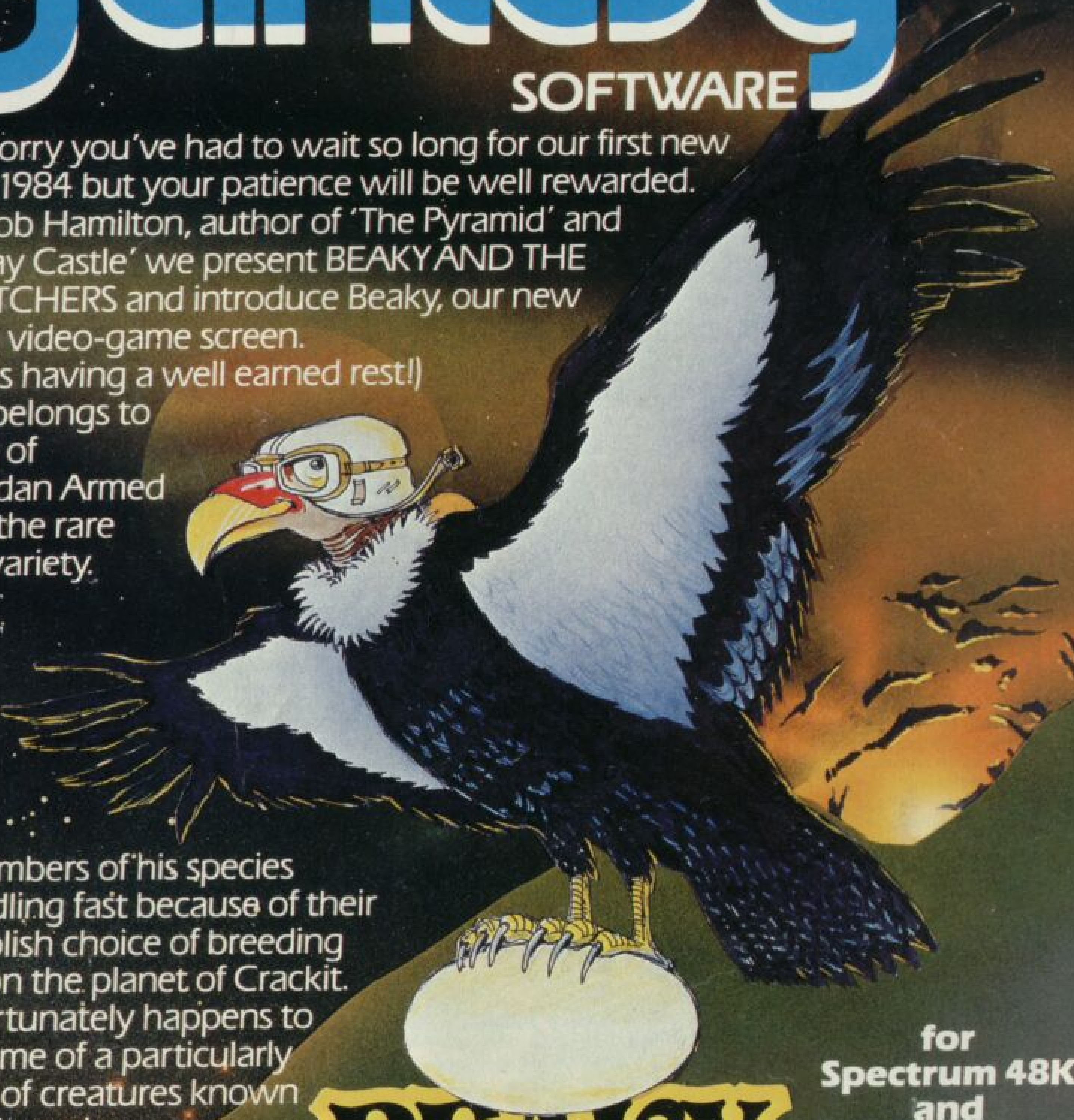
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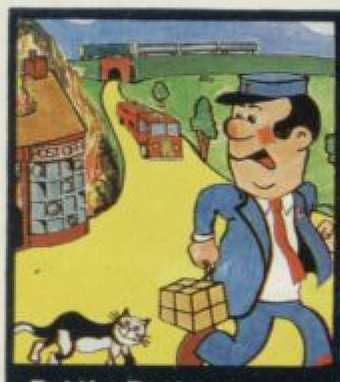
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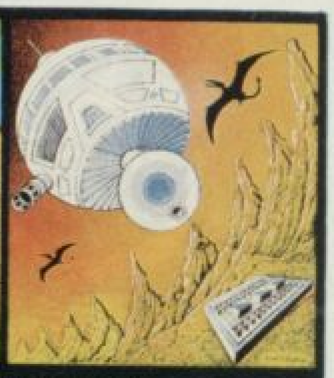
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```
740 IF INKEY$<>"" AND INKEY$<>"C" THEN
LET PS=PS+1: PRINT AT P(PS,1),P(PS,2);
OVER 1; INK 8; PAPER 8; INVERSE 0;"  ":
GO TO 770
750 IF INKEY$="C" THEN  LET COL=1: GO T
O 770
760 GO TO 710
770 IF PS=1 THEN  LET PR=10: GO TO 1030
780 IF PS=2 THEN  LET PR=20
790 IF PS=3 THEN  LET PR=30
800 IF PS=4 THEN  LET PR=50
810 IF PS=5 THEN  LET PR=100
820 IF PS=6 THEN  LET PR=200: GO TO 103
0
830 IF COL=1 THEN  GO TO 1030
840 IF INKEY$<>"" THEN  GO TO 840
850 GO TO 700
```

Lines 610-850 The 'Collect' and 'Gamble' routines. Most of this section of code deals with the 'Gamble' feature, controlling the flashing boxes and deciding which of the boxes you have chosen based on the split second you hit the Enter key.

```
860 LET PR=0
870 IF R(1,J(1,1))=R(2,J(2,1)) AND R(2,
J(2,1))=R(3,J(3,1)) AND V(R(1,J(1,1)),2)
<>0 THEN  LET PR=V(R(1,J(1,1)),2): GO TO
 990
880 IF R(1,J(1,1))=R(2,J(2,1)) AND V(R(
1,J(1,1)),1)<>0 THEN  LET PR=V(R(1,J(1,1
)),1): GO TO 990
890 IF R(1,J(1,1))=5 THEN  LET PR=10: G
O TO 990
900 LET MO=0
910 FOR A=1 TO 3
920 IF R(A,J(A,1))>7 THEN  LET MO=MO+VA
L F$(R(A,J(A,1)),1,1)
930 NEXT A
940 IF MO=0 THEN  RETURN
950 FOR A=LE+1 TO LE+MO: PRINT AT 0,A-1
; PAPER 8; INK 4;"tu": PAUSE A
960 IF A=27 THEN  LET PR=200: LET LE=2:
 LET FH=0: PRINT AT 0,2; PAPER 8; INK 8;
"u                         ": GO TO 990
970 NEXT A: LET LE=LE+MO
980 RETURN
```

Lines 860-980 This routine checks for a win on the wheels. After the wheels have finished spinning and have been nudged if the option was open, the resulting line is checked against the winning combinations specified on the left-hand side of the screen to see if you have won anything.

```
990 LET L=0: PRINT AT 20,16; PAPER 8; I
NK 8;"     ";AT 20,22;"  "
1000 LET L=L+1: BORDER 0: BORDER 2: BORD
ER 6: BORDER 4: BORDER 1: BORDER 0: IF L
<70 THEN  GO TO 1000
1010 IF PR=200 THEN  GO TO 1030
1020 IF PR>10 THEN  GO TO 610
1030 LET CRE=CRE+(PR/10)
1040 FOR A=1 TO 30 STEP 9: BEEP .001,A:
NEXT A: PRINT #1;AT 0,0;"       YOU WIN "
;PR;" PENNIES!": PAUSE 100
1050 PRINT #1;AT 0,0;"
                              "
1060 PRINT AT 20,1; PAPER 8; INK 8;"
   ";AT 20,9;"       ";AT 20,16;"     ";A
T 20,22;"  "
1070 PRINT AT 15,26-(LEN STR$ (CRE)); PA
PER 8;CRE
1080 LET HE=0
1090 IF PR=200 THEN  GO TO 1110
1100 PAUSE 20: LET HE=1: GO TO 1110: RET
URN
1110 FOR A=1 TO 6: FOR B=1 TO 6: PAUSE 1
1120 PRINT AT P(A,1),P(A,2); PAPER 8; IN
K 8; BRIGHT 1;P$(A)
1130 IF A=1 THEN  PRINT AT P(6,1),P(6,2)
; OVER 1; INVERSE 0; PAPER 8; INK 8; BRI
GHT 0;"  ": GO TO 1150
1140 PRINT AT P(A-1,1),P(A-1,2); INVERSE
 0; OVER 1; PAPER 8; INK 8; BRIGHT 0;"
"
1150 NEXT B: NEXT A: IF HE=1 THEN  PRINT
 AT P(6,1),P(6,2); PAPER 8; INK 8;"£2":
RETURN
1160 PAUSE 20: PRINT AT 4,25; PAPER 8; I
NK 8; FLASH 1; OVER 1;"  "
1170 FOR A=1 TO 60 STEP 8: BEEP .001,A:
NEXT A: FOR A=60 TO 30 STEP -9: BEEP .00
1,A: NEXT A
1180 PAUSE 50: PRINT AT 4,25; PAPER 8; I
NK 8; FLASH 0; OVER 1;"  "
1190 RETURN
```

Lines 990-1190 The 'win' routine. When you manage to get a winning line, this routine causes the BORDER to flash with various colours and a message telling you how much you have won appears at the bottom of the screen.

```
1200 STOP
1210 PRINT AT 7,12; INK C(R(1,J(1,2)));
PAPER 9;F$(R(1,J(1,2)),1);AT 8,12;F$(R(1
,J(1,2)),2)
1220 PRINT AT 10,12; INK C(R(1,J(1,1)));
 PAPER 9;F$(R(1,J(1,1)),1);AT 11,12;F$(R
(1,J(1,1)),2)
1230 PRINT AT 13,12; INK C(R(1,J(1,3)));
 PAPER 9;F$(R(1,J(1,3)),1);AT 14,12;F$(R
(1,J(1,3)),2)
1240 PRINT AT 7,15; INK C(R(2,J(2,2)));
PAPER 9;F$(R(2,J(2,2)),1);AT 8,15;F$(R(2
,J(2,2)),2)
1250 PRINT AT 10,15; INK C(R(2,J(2,1)));
 PAPER 9;F$(R(2,J(2,1)),1);AT 11,15;F$(R
(2,J(2,1)),2)
1260 PRINT AT 13,15; INK C(R(2,J(2,3)));
 PAPER 9;F$(R(2,J(2,3)),1);AT 14,15;F$(R
(2,J(2,3)),2)
1270 PRINT AT 7,18; INK C(R(3,J(3,2)));
PAPER 9;F$(R(3,J(3,2)),1);AT 8,18;F$(R(3
,J(3,2)),2)
1280 PRINT AT 10,18; INK C(R(3,J(3,1)));
 PAPER 9;F$(R(3,J(3,1)),1);AT 11,18;F$(R
(3,J(3,1)),2)
1290 PRINT AT 13,18; INK C(R(3,J(3,3)));
 PAPER 9;F$(R(3,J(3,3)),1);AT 14,18;F$(R
(3,J(3,3)),2)
1300 RETURN
```

Lines 1200-1300 This routine prints the wheels of the fruit machine in the centre of the screen whenever the reels have to be moved — during an ordinary spin or when the 'Nudge' option is offered.

```
1310 STOP
1320 PRINT AT 20,16; PAPER 8; INK 8;"
   ";AT 20,22;"  "
1330 LET CH=0
1340 PAUSE 30
1350 IF RND>.8 THEN  LET CH=1: GO SUB 18
0
1360 IF FH=0 THEN  PRINT AT 0,2; PAPER 8
; INK 8;"u                         ";AT
 18,19;"          ": LET LE=2
1370 IF FH=1 AND RND>.5 AND CH<>1 THEN
LET FH=0: PRINT AT 18,19; PAPER 8; INK 8
;"          ": GO TO 1360
1380 PRINT AT 20,26; INK 9; PAPER 8; FLA
SH 1;"START"
```

```
1390 FOR A=1 TO 200: IF INKEY$=CHR$ 13 T
HEN  GO TO 1410
1400 NEXT A: GO SUB 2210
1410 PRINT AT 20,26; INK 8; PAPER 8; FLA
SH 0;"START";
1420 PRINT AT 16,12; PAPER 8; INK 8; OVE
R 1; FLASH 0;"        "
1430 PRINT AT 16,12; OVER 1; FLASH 0; PA
PER 8; INK 8;"        "
1440 FOR R=1 TO INT (RND*5)+2: FOR A=1 T
O 3: IF T(A)=1 THEN  GO TO 1480
1450 IF A=3 AND T(A)=1 THEN  GO TO 1500
1460 FOR B=1 TO 3: LET J(A,B)=J(A,B)-1:
IF J(A,B)<1 THEN  LET J(A,B)=15
1470 NEXT B
1480 NEXT A: GO SUB 1210: NEXT R
1490 BEEP .01,20
1500 FOR R=1 TO INT (RND*5)+2: FOR A=2 T
O 3: IF T(A)=1 THEN  GO TO 1540
1510 IF A=3 AND T(A)=1 THEN  GO TO 1560
1520 FOR B=1 TO 3: LET J(A,B)=J(A,B)-1:
IF J(A,B)<1 THEN  LET J(A,B)=15
1530 NEXT B
1540 NEXT A: GO SUB 1210: NEXT R
1550 BEEP .01,20
1560 FOR R=1 TO INT (RND*5)+2: IF T(3)=1
 THEN  GO TO 1610
1570 FOR B=1 TO 3: LET J(3,B)=J(3,B)-1:
IF J(3,B)<1 THEN  LET J(3,B)=15
1580 NEXT B
1590 NEXT A: GO SUB 1210: NEXT R
1600 BEEP .01,20
1610 FOR A=1 TO 3: LET T(A)=0: NEXT A
1620 PRINT AT 16,12; PAPER 8; INK 8;"ab
ab ab"
1630 IF RND>.95 THEN  GO SUB 280
1640 RETURN
```

Lines 1310-1640 This routine controls the main running of the program, calling various subroutines when necessary.

```
1650 STOP
1660 RESTORE 1660: PAPER 7
1670 FOR A=USR "A" TO USR "U"+7
1680 READ U: POKE A,U
1690 NEXT A
1700 DIM F$(10,2,2): DIM R(3,15): DIM T(
3): LET CH=0: LET LE=2
1710 DIM V(10,2): DIM P$(6,2): DIM P(6,2
): DIM C(10): DIM J(3,3): LET CRE=10: LE
T NC=0: LET FH=0
1720 FOR A=1 TO 10
1730 READ F$(A,1),F$(A,2),V(A,1),V(A,2),
C(A)
1740 NEXT A
1750 FOR A=1 TO 3: FOR B=1 TO 15
1760 READ R(A,B): NEXT B: NEXT A
1770 FOR A=1 TO 6
1780 READ P(A,1),P(A,2)
1790 NEXT A: FOR A=1 TO 3: FOR B=1 TO 3:
 READ J(A,B): NEXT B: NEXT A
1800 FOR A=1 TO 6: READ P$(A): NEXT A
1810 DIM R$(10,32): FOR A=1 TO 10: READ
R$(A): NEXT A
1820 RETURN
```

Lines 1650-1820 The 'initialise' routine. This sets up the arrays, defines UDGs, etc.

```
1830 DATA 0,82,85,117,85,85,82,0
1840 DATA 0,70,69,69,69,69,118,0
1850 DATA 0,87,84,119,84,84,87,0
1860 DATA 0,0,1,7,15,15,15,15
1870 DATA 0,0,128,224,176,208,208,240
1880 DATA 15,31,31,31,31,127,1,0
1890 DATA 240,248,248,248,248,254,128,0
1900 DATA 0,0,7,15,31,63,127,127
1910 DATA 0,0,224,240,152,236,254,254
1920 DATA 127,127,63,31,15,7,0,0
1930 DATA 254,254,252,248,240,224,0,0
1940 DATA 0,31,59,63,63,127,123,127
1950 DATA 0,240,232,248,248,120,240,224
1960 DATA 63,61,63,31,14,15,15,6
1970 DATA 192,64,192,128,128,128,0,0
1980 DATA 0,63,0,63,63,39,42,38
1990 DATA 0,254,0,254,254,102,170,38
2000 DATA 42,42,38,63,63,0,63,0
2010 DATA 170,170,170,254,254,0,254,0
2020 DATA 126,191,255,255,255,126,60,102
2030 DATA 124,254,245,254,240,252,60,0
```

Lines 1830-2030 Contain the data for the second bank of UDGs (from A to U).

```
2040 DATA "de","fg",0,100,6
2050 DATA "hi","jk",30,50,2
2060 DATA "hi","jk",30,50,3
2070 DATA "hi","jk",20,30,6
2080 DATA "lm","no",20,50,3
2090 DATA "pq","rs",0,100,0
2100 DATA "K/","/K",0,100,5
2110 DATA "5*","*5",0,0,6
2120 DATA "4*","*4",0,0,5
2130 DATA "3*","*3",0,0,4
2140 DATA 1,8,5,4,9,6,4,10,2,8,7,3,10,4,
9
2150 DATA 6,10,8,3,4,1,5,9,4,2,7,10,9,4,
8
2160 DATA 5,3,4,10,6,1,9,7,8,4,10,2,9,4,
8
2170 DATA 14,29,12,27,10,28,8,26,6,27,4,
25
2180 DATA 1,15,2,1,15,2,1,15,2
2190 DATA "10","20","30","50","£1","£2"
2200 DATA "   I'M A K-K-KRAZY KATAPILLA!
"," STILL IN CREDIT - NOT FOR LONG","  B
Y TROUBLESHOOTING PETE 1984","YS, THE BE
ST MAG FOR YOUR SPECCY","         THE QL
 EXISTS!","LET'S GET ON WITH THE GAME TH
EN!","       WHY ARE WE WAITING?","    D
ON'T 'ANG AROUND THEN","        BYTE HIGH
 - NO LIMIT","OK, PRESS THE START BUTTON
DUMMY"
```

Lines 2040-2200 Contain the data for the contents of the wheels, the value of the prizes, and the other various arrays in the program.

```
2210 LET KL=1: LET K1=1: LET K2=13: LET
K3=10: LET K5=0: LET KA=1
2220 IF INKEY$=CHR$ 14 THEN  GO TO 2450
2230 PRINT AT P(K1,1),P(K1,2); BRIGHT 1;
 PAPER 8; INK 8;P$(K1)
2240 LET KL=KL+KA: PRINT AT 0,KL; PAPER
0; INK 4;"tu ": IF KL>28 THEN  LET KA=-1
2250 IF KL<1 THEN  LET KA=1
2260 IF K1=1 THEN  PRINT AT P(6,1),P(6,2
); BRIGHT 0; PAPER 8; INK 8;P$(6): GO TO
 2280
2270 PRINT AT P(K1-1,1),P(K1-1,2); BRIGH
T 0; PAPER 8; INK 8;P$(K1-1)
2280 LET K1=K1+1: IF INKEY$=CHR$ 13 THEN
  GO TO 2450
2290 IF K1=7 THEN  LET K1=1
2300 PRINT AT 4,K2; BRIGHT 1; PAPER 8; I
NK 8; OVER 1;" "
2310 IF K2=13 THEN  PRINT AT 4,21; BRIGH
T 0; PAPER 8; INK 8; OVER 1;" "
2320 PRINT AT 4,K2-1; BRIGHT 0; PAPER 8;
 INK 8; OVER 1;" "
2330 LET K2=K2+1: IF INKEY$=CHR$ 13 THEN
```

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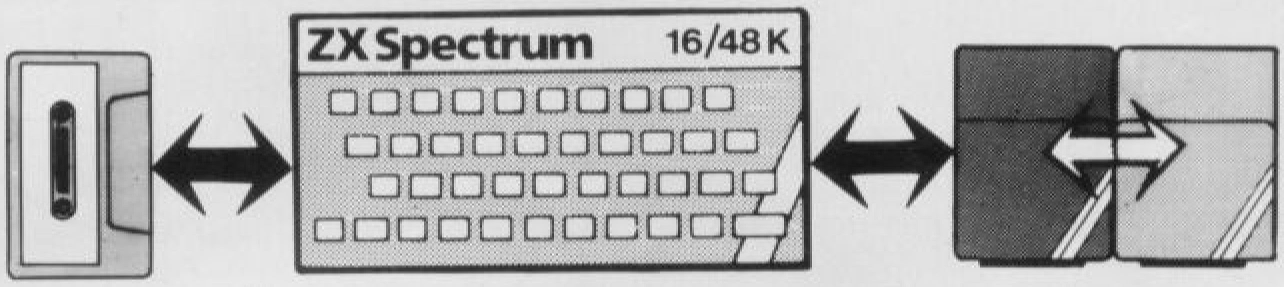
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```
 GO TO 2450
2340 IF K2=22 THEN  LET K2=13
2350 PRINT AT 4,10; PAPER 8; INK 5; OVER
 1; BRIGHT 0;"    "
2360 IF K3/2=INT (K2/2) THEN  PRINT AT 4
,10; PAPER 8; INK 7; OVER 1; BRIGHT 1;"
  "
2370 IF INKEY$=CHR$ 13 THEN  GO TO 2450
2380 PRINT AT 3,K3; PAPER 1; INK 9; OVER
 1;" "
2390 IF K3=10 THEN  PRINT AT 3,21; PAPER
 5; INK 9; OVER 1;" ": GO TO 2410
2400 PRINT AT 3,K3-1; PAPER 5; INK 9; OV
ER 1;" "
2410 LET K3=K3+1: IF INKEY$=CHR$ 13 THEN
  GO TO 2450
2420 IF K3=22 THEN  LET K3=10
2430 LET K5=K5+1: IF K5=20 THEN  LET K5=
0: GO SUB 2510
2440 GO TO 2220
2450 PRINT AT 3,10; PAPER 5; INK 9;"YOUR
 SPECCY!"
2460 PRINT AT 4,10; PAPER 0; INK 5; BRIG
HT 0; OVER 1;"    "; INK 6;"           "
2470 PRINT #1;AT 0,0;"
                     "
2480 FOR A=1 TO 6: PRINT AT P(A,1),P(A,2
); PAPER 1; INK 7;P$(A): NEXT A
2490 PRINT AT 0,0; PAPER 0; INK 4;"ttu
                     "
2500 RETURN
2510 LET K6=INT (RND*10)+1: PRINT #1;AT
0,0;R$(K6): RETURN
```

Lines 2210-2510 The 'waiting' routine. While the player is not using the program, this routine prints up a number of on-screen messages to keep the user amused.

```
2520 PAPER 0: INK 9: CLS
2530 RESTORE 2520
2540 FOR a=USR "a" TO USR "J"+7
2550 READ u: POKE a,u: NEXT a
2560 DATA 0,8,28,62,62,62,127,8
2570 DATA 0,127,0,127,127,127,0,127
2580 DATA 0,82,100,88,26,44,74,0
2590 DATA 0,8,63,62,30,28,24,16
2600 DATA 0,28,38,79,127,127,62,28
2610 DATA 0,86,85,102,85,85,85,0
2620 DATA 0,39,81,114,82,84,87,0
2630 DATA 0,80,80,32,32,32,32,0
2640 DATA 126,191,255,255,255,126,60,102
2650 DATA 124,254,245,254,240,252,60,0
2660 PRINT AT 4,10; INK 5;"fgh"; INK 6;"
KATAPILLA"
```

Lines 2520-2660 Contain the data for the first bank of UDGs (from A to J). These are used to draw on the screen and include the symbols displayed in the 'win information' windows and the 'little' letters which make up the word 'KRAZY'.

```
2670 PRINT AT 6,11;"▛";AT 6,20;"▜";AT 15
,11;"▙";AT 15,20;"▟"
2680 PLOT 88,88: DRAW 79,0
2690 PLOT 88,87: DRAW 79,0
2700 PLOT 88,124: DRAW 79,0
2710 PLOT 88,128: DRAW 79,0
2720 PLOT 88,48: DRAW 79,0
2730 PLOT 88,52: DRAW 79,0
2740 PLOT 88,48: DRAW 0,79
2750 PLOT 167,48: DRAW 0,79
2760 PLOT 116,52: DRAW 0,71
2770 PLOT 115,52: DRAW 0,71
2780 PLOT 140,52: DRAW 0,71
2790 PLOT 139,52: DRAW 0,71
```

Lines 2670-2790 Draw the wheels in the centre of the screen.

```
2800 PAPER 1
2810 PRINT AT 3,24;"      "
2820 PRINT AT 4,24;" £2 "
2830 PRINT AT 5,24;"        "
2840 PRINT AT 6,26;" £1 "
2850 PRINT AT 7,25;"      "
2860 PRINT AT 8,25;" 50 "
2870 PRINT AT 9,25;"      "
2880 PRINT AT 10,27;" 30 "
2890 PRINT AT 11,26;"      "
2900 PRINT AT 12,26;" 20 "
2910 PRINT AT 13,26;"      "
2920 PRINT AT 14,28;" 10 "
2930 PRINT AT 15,28;"    "
2940 PAPER 0
2950 PLOT 191,152: DRAW 32,0: DRAW 0,-24
: DRAW -32,0: DRAW 0,24
2960 PLOT 224,136: DRAW 16,0: DRAW 0,-24
: DRAW -32,0: DRAW 0,14
2970 PLOT 207,120: DRAW -8,0: DRAW 0,-24
: DRAW 32,0: DRAW 0,14
2980 PLOT 232,104: DRAW 16,0: DRAW 0,-24
: DRAW -32,0: DRAW 0,14
2990 PLOT 215,88: DRAW -8,0: DRAW 0,-24:
 DRAW 32,0: DRAW 0,14
3000 PLOT 240,72: DRAW 15,0: DRAW 0,-24:
 DRAW -31,0: DRAW 0,14
```

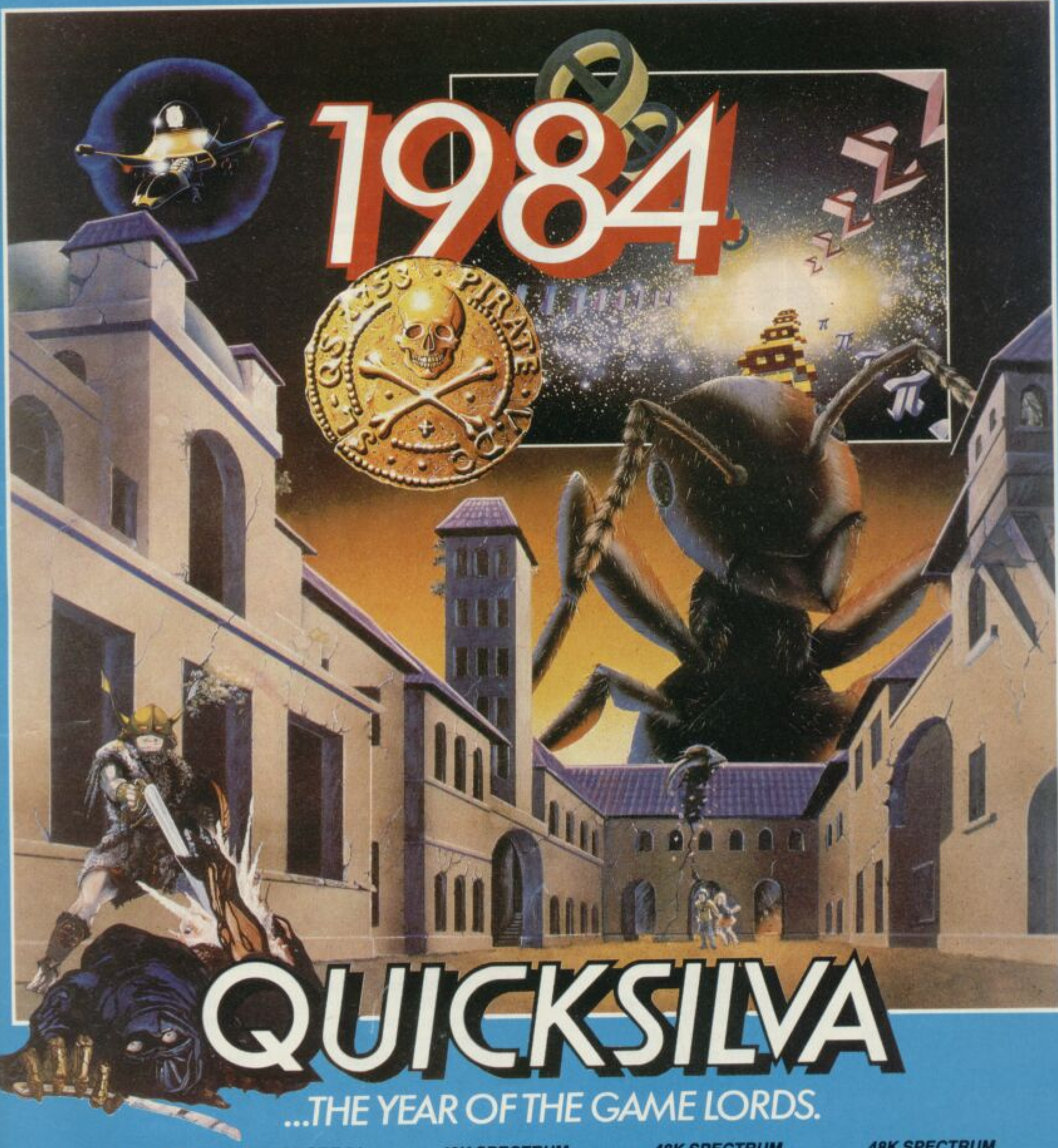
Lines 2800-3000 Draw the 'Gamble' feature boxes.

```
3010 PLOT 207,16: DRAW 41,0: DRAW 0,-9:
DRAW -41,0: DRAW 0,9: PRINT AT 20,26; PA
PER 2;"     "
3020 PLOT 175,16: DRAW 17,0: DRAW 0,-9:
DRAW -17,0: DRAW 0,9: PRINT AT 20,22; PA
PER 5;"  "
3030 PLOT 127,16: DRAW 41,0: DRAW 0,-9:
DRAW -41,0: DRAW 0,9: PRINT AT 20,16; PA
PER 5;"     "
3040 PLOT 71,16: DRAW 49,0: DRAW 0,-9: D
RAW -49,0: DRAW 0,9: PRINT AT 20,9; PAPE
R 5;"      "
3050 PLOT 7,16: DRAW 57,0: DRAW 0,-9: DR
AW -57,0: DRAW 0,9: PRINT AT 20,1; PAPER
 5;"       "
3060 PLOT 151,32: DRAW 97,0: DRAW 0,-9:
DRAW -97,0: DRAW 0,9: PRINT AT 18,19; PA
PER 5;"            "
```

Lines 3010-3060 Draw the information windows at the bottom of the screen.

```
3070 PLOT 7,152: DRAW 49,0: DRAW 0,-26:
DRAW -49,0: DRAW 0,26
3080 PRINT AT 3,1; INK 6;"aaa "; INK 7;"
£1";AT 4,1;"bbb £1";AT 5,1; INK 5;"ccc "
; INK 7;"£1"
3090 PLOT 23,120: DRAW 49,0: DRAW 0,-26:
 DRAW -49,0: DRAW 0,26
3100 PRINT AT 7,3; INK 2;"eee "; INK 7;"
50";AT 8,3; INK 3;"eee "; INK 7;"50";AT
9,3; INK 3;"ddd "; INK 7;"50"
3110 PLOT 15,88: DRAW 49,0: DRAW 0,-26:
DRAW -49,0: DRAW 0,26
3120 PRINT AT 11,2; INK 6;"eee "; INK 7;
"30";AT 12,2; INK 2;"ee- "; INK 7;"30";A
T 13,2; INK 3;"ee- "; INK 7;"30"
3130 PLOT 31,56: DRAW 49,0: DRAW 0,-26:
DRAW -49,0: DRAW 0,26
3140 PRINT AT 15,4; INK 6;"ee- "; INK 7;
"20";AT 16,4; INK 3;"dd- "; INK 7;"20";A
T 17,4; INK 3;"d-- "; INK 7;"10"
3160 PRINT AT 1,30;"£2"
3170 RETURN
```

Lines 3070-3170 Draw the 'win' information boxes and return to the main program.



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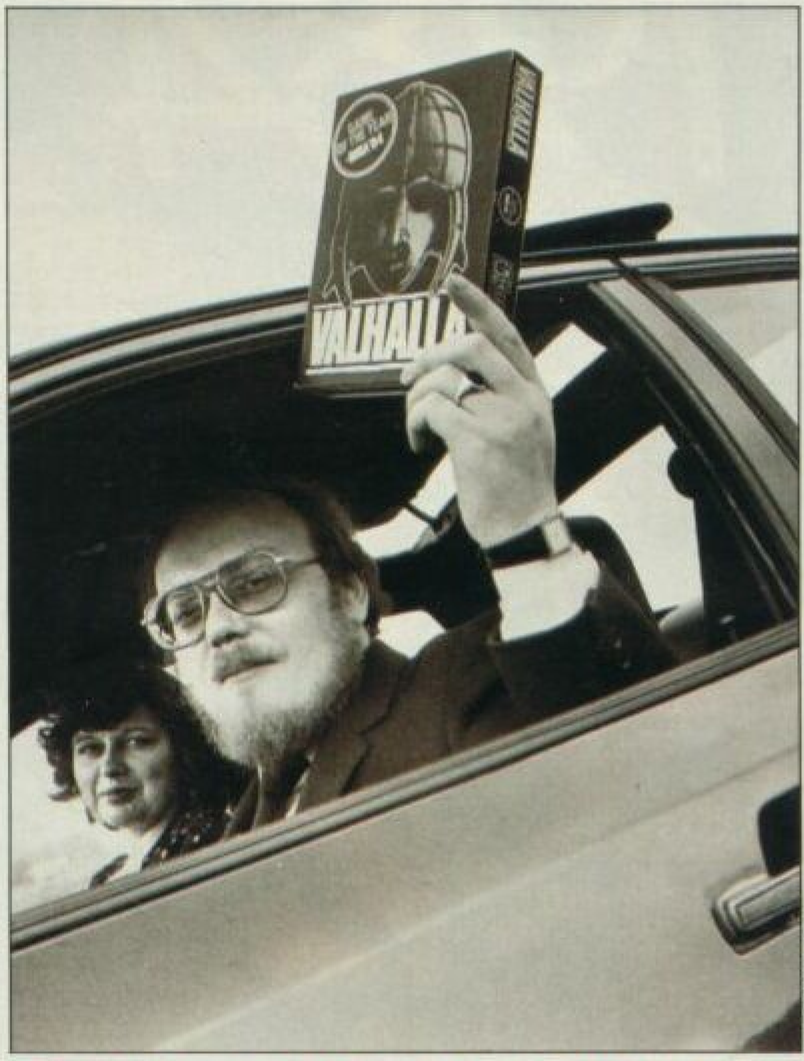
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In a never-to-be-forgotten journey,* Phil Manchester *breached the icy wastes of the south, in search of the legendary halls of Valhalla and the chariots of the gods — only to find a clapped-out Porsche . . .



TONY SLEEP

UNVEILING VALHALLA

And in those times were sorcerers who wrought magnificent adventures from machines of sand and copper. With mystic writings and cunning they made works to seduce the eye and occupy the thoughts for endless hours. Their wares were spread far and wide by pedlars who traversed the land.

In the southland, on the fringes of civilisation, one of these sorcerers forged a mighty adventure with all manner of possibilities — and his name was Peel. And scribes came from far and wide to hear his wisdom and write it down in the language of that time. Here follows the writings of one of those scribes.

You are in an icy wasteland in Hell. You can go south or west.

South — to Purley. Catch the Iron Way from London Bridge and the great diesel dragon will carry you through the southern wastes of the metropolis to the neat suburbia of Croydon. Beyond that — before you reach the wilderness — you hit Purley.

Taxis are in short supply and it meant your humble author was about an hour late arriving at the Italian restaurant in Purley where I was to meet John and Jan Peel, the people behind *Valhalla*.

Thor brings the wine. Thor give me the wine. You drink the wine.

For those that do not know *Valhalla*, it's an adventure game with animated action. John Peel calls it a piece of 'Movie Software' and claims it breaks new ground in computer games. "*The Hobbit* was a milestone in commercial terms but until *Valhalla* came along there was nothing new", he said.

It may be coincidence that the dialogue between you as the player and the *Valhalla* program is just a little like 'Janet and John' books. I never broached the subject with either Jan or John. But Janet and Johnish it is. The come-on in the adverts and images surrounding the game is aimed very much at the sort of person you might find in a second-hand record shop looking for old *Genesis* records; the software equivalent of heavy metal music with visions of a fantasy world where everything is either good or bad — binary morality.

"You start midway between good and evil", explains Jan, the person responsible for what she calls the characterisation of *Valhalla*. "You have to convince the goodies that you are worth helping. But you can take another route and be thoroughly bad and get the help of the baddies. There are lots of possibilities."

Thor brings the food. Thor give me the food. You eat the food.

The Peels are quick to refute any accusations that *Valhalla* exploits the less savoury side of human nature and the image of the game is, if anything, an incorrect reflection of what it's about. "You can take an absolute baddy like Loki and change him into a goody — that sort of thing does not need to be there commercially", Jan emphasised.

John readily admits that the product 'fuels fantasy' and draws parallels with television soap operas. "We are looking for TV quality images coupled with the interactive potential of a home computer", he said. "We're on the point of a revolution in leisure arts and *Valhalla* is one way it can go," adds Jan.

The choice of the Spectrum as the machine to accompany the first version of *Valhalla* was a calculated one. "It was obvious that the Spectrum was going to be a success when it was launched. We wanted to cash in on the arrival of a mature micro", John explained.

But he is far from satisfied with the current standard of home micros. "The history of microcomputing is the history of the adoption of appalling standards. Take graphics, for instance. People want good graphics for games and other things and it takes a lot of memory. Despite that, the software people working on products have done an amazing job with what's there", he added.

You attack the dragon. You defeat the dragon. The dragon leaves.

In the end, like anyone else in the software game, the Peels are out to make money and *Valhalla* promises to be a source of great riches to them. They estimate that 'at the end of the day' it will gross about £5 million worldwide. This means that they can now afford the trappings and status symbols of successful software entrepreneurs — including the mandatory black Porsche. "It only has a few miles on the clock because we've had trouble with it since we bought it. We'll have to keep our old Datsun on the road for a bit longer", John moaned.

Looking to the future, their formula to buy more Porsches is to look to ever more sophisticated software for use with home computers — incorporating things like speech recognition when it comes along. "People dismiss games as trivia, when in fact they are great source of funding. We can see great potential beyond the sort of game that's sold at present and that's what we are going for," enthused John.

Thor brings the taxi. You take taxi. Thank you Thor.

And so it came to pass that the scribe departed from the land beyond the great river and journeyed north on the Iron Way. As he pondered on what that had been revealed to him by the wizards of Legend he wondered if he was real — or just an animated special character in a computer game.

When, some days later he was wearing the magic sweatshirt given to him by the wizards, embossed with the word 'VALHALLA', and a passer-by asked "Who are Valhalla — some sort of rock band?", the scribe merely smiled, for he knew then that he was real. YS

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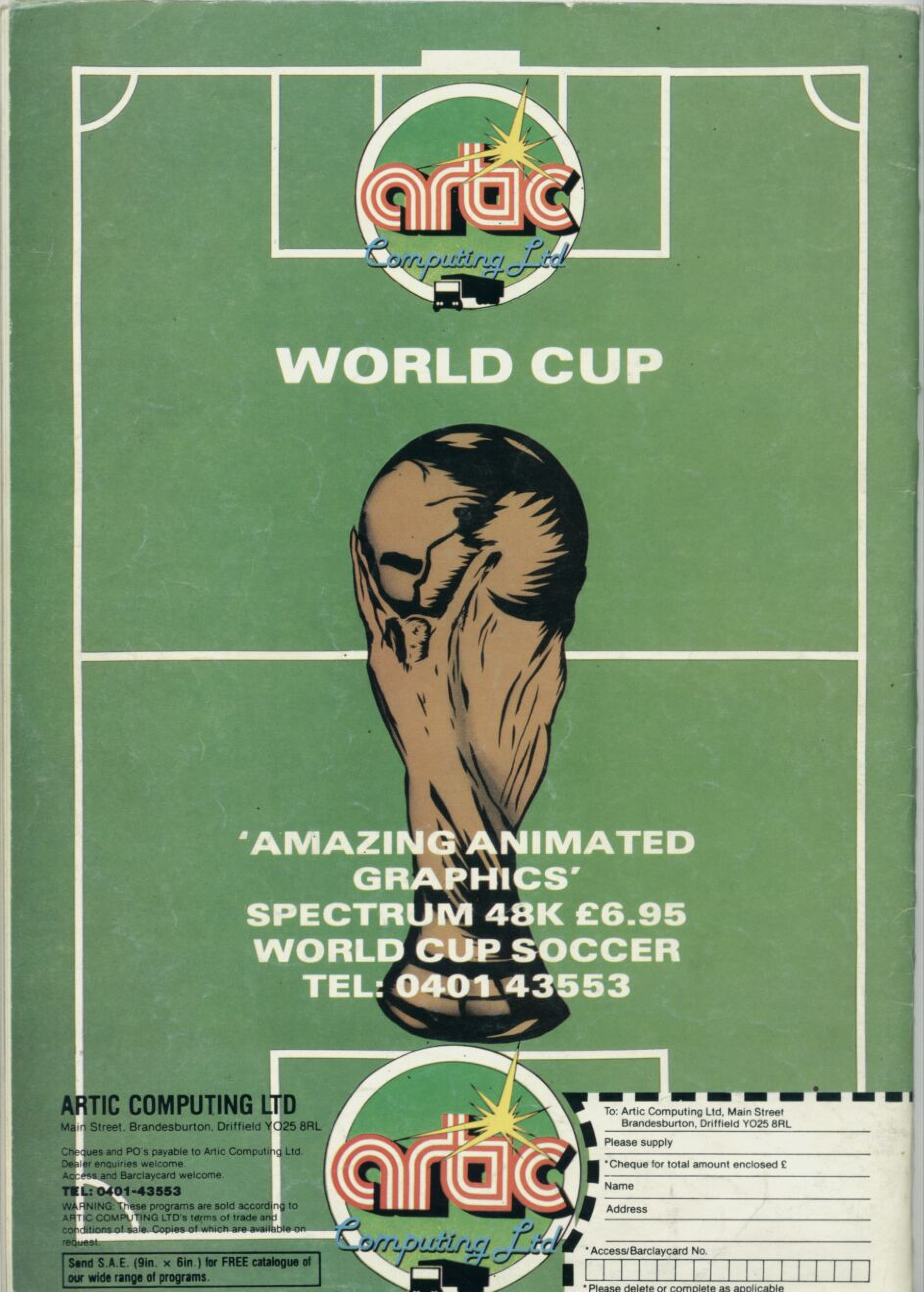
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